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## ACCEPTANCE

This dissertation, EXAMINING THE INTEGRATION AND USE OF CULTURALLY RESPONSIVE MATHEMATICS PEDAGOGY IN PRESERVICE TEACHERS REFLECTIONS AND PRACTICE: IMPLICATIONS FOR BLACK CHILDREN, by NATASHA RAMSAY-JORDAN, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Education, in the College of Education and Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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EXAMINING THE INTEGRATION AND USE OF CULTURALLY RESPONSIVE MATHE-  
MATICS PEDAGOGY IN PRESERVICE TEACHERS REFLECTIONS AND PRACTICE:  
IMPLICATIONS FOR BLACK CHILDREN

by

**NATASHA N. RAMSAY-JORDAN**

Under the Direction of Dr. Pier A. Junor Clarke

**ABSTRACT**

Prospective teachers of diverse students such as Black children, need to have opportunities in their professional study to develop the shared knowledge, perceptions and attitudes required for effective implementation of culturally responsive mathematics pedagogy. This instrumental qualitative case study began investigative and exploratory work through the coupling of qualitative research methodology and critical race theory to examine four preservice secondary mathematics teachers' (PSMTs) experiences using culturally responsive mathematics pedagogy (CRMP) in classrooms to teach Black children. The research questions addressed were: How do PSMTs negotiate their experiences of teaching mathematics to Black children while immersed in CRMP professional learning activities during their practicum? What affordances or constraints do PSMTs identify when using CRMP practices? Participants in the study explored their experiences with CRMP by addressing race, socio political, and cultural issues within education. An analysis of the data revealed that the participants' experiences integrating and using CRMP

were heavily impacted by: a) interpersonal and intrapersonal race relationships; b) immersion in CRMP learning activities; c) understanding of CRMP tenets; and d) school policies and practices. Perhaps the most important take away from the analysis of this study's data and discussion is that interpersonal and intrapersonal relationships both inside and outside of the mathematics classroom as it relates to how PSMTs situate themselves racially and culturally serve as impetus to how CRMP is integrated and used to teach Black children. The findings of this study have implications for teacher preparation programs and educators who aim to become more culturally responsive in their mathematics classroom while seeking to improve and promote academic success of Black children in mathematics.

INDEX WORDS: Culturally responsive pedagogy, Culturally responsive mathematics pedagogy, Black children, Preservice secondary mathematics teachers, Critical race theory, Race, Culture, Education



Examining the Integration and Use of Culturally Responsive Mathematics Pedagogy in  
Preservice Teachers Reflections and Practice: Implications for Black Children  
by

Natasha Ramsay-Jordan

A Dissertation

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Degree of

Doctor of Education

in

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in

Middle and Secondary Education

in the

College of Education and Human Development

Georgia State University

Atlanta, GA  
2017

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## **DEDICATION**

I dedicate this dissertation to my five heartbeats, also known as my husband Michael and our four children Askia, Asaru, AmunRa, and Akenti.

I Love you always.

This dissertation is also dedicated to the spirit, love, friendship, and memories of my dear mother Rosemay, my hardworking father Frederick, my sweet sister Sharon, my darling niece Mandy, and my kindhearted nephew Marlon.

You are forever in my heart.

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## FOREWORD

### My Culturally Responsive Story

As a Black woman from a culture outside of the United States (U.S.), my U.S. schooling experiences have left an indelible mark on my perspective of education – particularly as it relates to the ways in which culturally and linguistically diverse (CLD) students are educated. CLD students are a diverse group of learners in terms of their education, native language literacy, socioeconomic status, and cultural traditions (Doran, 2014). For me, being a CLD student stemmed from my upbringing in South America. Over 30 years ago, my family and I moved from Guyana, a small South American / Caribbean country to Brooklyn, New York, where I attended schools in Bedford Stuyvesant alongside other students of African descent. During my years in Guyana, I felt confident in my abilities to comprehend and complete tasks in subject areas such as mathematics, reading, and writing, as well as my abilities to articulate myself verbally and in writing. Educators in Guyana taught in ways that honored students' rich cultural backgrounds and experiences, and because of this, I felt a great deal of success. Yet, my academic identity of excellence was shortly diminished in my transition to schools in the U.S. and I quickly learned that it was challenging for my teachers to advance my learning. Particularly, my language, writing, and self-expression, conflicted with my U.S. teachers' pedagogical practices for teaching CLD students like myself. The cultural differences in the way I spoke or spelled words such as *colour*, *favour*, *programme*, as well as my overall cultural experiences proved to be problematic for my teachers. The mathematics procedures I used to solve problems and the explanations I gave for my understanding of mathematical concepts were different and therefore dismissed by my teachers. Rather than view my ways of knowing, which involved differences in grammar, word usage, and mathematical computations as resources, my teachers viewed them as deficiencies that inhibited my

success in mathematics. For example, during my middle school years, which included grades six through eight, I had embarrassing experiences and interactions with my teachers. These disconcerting experiences included being mocked and laughed at when I read aloud and pronounced words differently, and when my assignments were graded and ridiculed for its different approach in problem solving and shown to the class.

Overall, the cultural differences of my language use in terms of dialect, and spelled words were problematic issues that dominated my middle school learning environment and negatively influenced my overall academics. Throughout my middle school academic years, many of my middle school teachers highlighted 'misspelled' words and considered assignment responses with 'misspelled' words incorrect. Due to these practices, I received lower grades in my middle school classes and was even considered at risk of failing. My teachers continuously engaged in discourse that encouraged and supported the isolation of CLD students like myself, and gave rise to self-doubt with regards to my middle school academics. I recall many of my middle school teachers laughing at the way I spoke while uttering words of “go back on the banana boat.” For the duration of my middle school experience, I became introverted and disconnected from my learning environment. The cultural disjointedness caused me to continuously doubt myself, and my confidence in my abilities as a learner. I became embarrassed to speak, or write publicly. My teachers’ lack of adequate preparation or demonstration of culturally relevant instructional practices toward me is part of a larger problem found in far too many U.S. public schools that involves low teacher expectations of culturally diverse students, poor student academic achievement, low student self-esteem, and further marginalization of CLD students (Toldson & Johns, 2016).

My experiences in middle school are not different from other youths who are not experiencing success in schools, and help to explain why researchers, such as, Banks and Banks (1995), Gay (2000), Hale (1982), Irvine (2003; 2010), Ladson-Billings (1995a), and many others, have called for teachers to utilize culturally responsive or culturally relevant pedagogical practices in their classrooms. Culturally relevant and culturally responsive pedagogy (CRP) are terms, which I use interchangeably in this study. Discussed in more detail in the next chapter, CRP is an ideology and practice, which requires the utilization of students' culture as a vehicle for learning (Gay, 2002; Irvine, 2010; Ladson-Billings, 1995a). Its fundamental principle is based on synthesizing race matters, culture, and education. CRP plays an intricate part of current reform efforts to improve teacher education programs by infusing such programs with commitments to social justice and equity (Larnell, Bullock & Jett, 2016; Leonard & Moore, 2014). Given that my U.S. education schooling experiences as a CLD Black child are not uncommon when compared to native born Black children in the U.S., supporters of CRP maintain that culturally responsive instructional practices in classrooms will support inclusive and equitable educational experiences for Black children (Hall & Martin, 2013; Hubert, 2014).

## CHAPTER 1 INTRODUCTION

According to the United States (U.S.) Department of Education's mission statement, the overall goal of educating children in the U.S. is to promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access for all students (U.S. Department of Education, 2017). Although this current mission statement and consequent policies appeal to the idea of educational equality, historically, Black children in U.S. public schools have experienced inequitable treatment stemming from culturally biased perspectives that favor White children. For example, traditionally, Black children have been subjected to culturally biased tests including aptitude, achievement, and career or vocational tests both in construct and content that render them genetically less intelligent to White children (Ford, 2007). Moreover, there is a continued legacy of denying culturally diverse and marginalized students, such as Black children, equitable access to culturally responsive educational experiences (Anderson, 1988; Leonard & Martin, 2013, Oliver & Oliver, 2013) which involves honoring cultural differences, awakening critical consciousness and maintaining students' cultural competence and self-efficacy. This inequitable access is paramount to the current mathematics experiences of Black children especially when we consider that mathematics has become a top priority in education (Phillips, 2014), and those who are successful in mathematics education are viewed as intelligent (L. Waddell, 2014). Mathematics is regarded as a subject that requires critical thinking and those successful in mathematics are often revered (Davis & Hersh, 1998). This connection of mathematics and one's ability to think has led to mathematics being seen as a privileged subject

in U.S. education and a gatekeeper for access to: a) good paying jobs; b) higher education; c) understanding and creation of technology; and d) improved socioeconomic status (L. Waddell, 2014)

Researchers have argued for the support of culturally responsive pedagogy (CRP) as a necessary approach to teach Black children mathematics (Bonner, 2014; Hernandez, Morales, & Shroyer, 2013; Jett, 2013). CRP is a viable means to teach Black children mathematics not just to possibly increase interest and achievement but also as a more useful holistic approach to mathematics. It is postulated that teachers using culturally responsive practices in mathematics classrooms can create spaces and opportunities for Black children to think with and about mathematics critically and in useful ways that are applicable to their lives. These useful ways involve getting students to use the fundamentals of mathematics, such as critical and logical thinking to address social, political, and environmental issues. Matthews, Jones, and Parker (2013) provided evidence of practicing teachers who designed and used culturally responsive and cognitively demanding mathematics tasks to deliberately empower students intellectually, socially, emotionally, and politically. Bonner (2014), and Waddell (2014) also provided commentary and evidence of teachers using culturally responsive teaching practices to afford Black students with opportunities to apply mathematics in their daily lives. While teachers like those highlighted by Bonner (2014); Matthews et al., (2013); and Waddell (2014) have sought to build the mathematical knowledge of students in culturally connected ways, there continues to be a disconnect in mathematics classrooms between Black students and their teachers.

## **Problem Statement**

As recent as the 1950s and 1960s mathematics experiences of Black children could be characterized as benign neglect (Berry, Pinter, & McClain, 2013) which means that the U.S. education system did not intervene in Black children's mathematics experiences to provide them with continual, necessary and appropriate services that would benefit Black children. For example, learning materials such as mathematics textbooks that Black children received were handed down from White schools to serve as their curriculum (Leonard & Martin, 2013). Even as the U.S. began to focus on competing on a global level through improving the mathematics education of its students in K-12, White children and their schools were the primary focus and received appropriate funding (Darling-Hammond, 2010; Ostrander, 2015). Black children were not envisioned as part of the focus on strengthening students understanding of mathematics. For Black children, their schools and learning environments were underfunded as compared to their White counter parts. Moreover, Black children received poor quality instructional materials, limited resources and limited, if not inadequate, pedagogical and curricular methods that were incongruent with their culture. According to Darling-Hammond (2010), more than 20 states in the U.S. have significantly fewer resources for Black children and their schools on every tangible measure including class sizes, textbooks, computer, facilities, and curriculum offerings. In 2014, the U.S. Department of Education Office of Civil Rights college readiness report found that a quarter of high schools with the highest percentage of Black children, did not offer basic mathematics courses such as Algebra II as compared to schools with predominantly White students. Despite disproportional funding and culturally incongruent pedagogical practices that has minimized the inclusion, support, and contributions of Black people in mathematics, historically Black people have contributed to the advancement of mathematics. In the paragraphs that follow

I highlight some mathematics contributions of Black people and discuss current operating systems for Black children in U.S. schools.

**Contributions of Black people in mathematics.** Historical contributions to the history and development of mathematics have been researched by various scholars (D'Ambrosio, 1985; Davis & Hersh, 1998; Gilsdorf, 2012; Joseph, 1991). What has been found, unsurprisingly, is that diverse civilizations have contributed to mathematics. However, although many different cultures—who were often people of color have contributed richly to the development of mathematics, most research scholars have promoted Western and Eurocentric perspectives of mathematics (Gilsdorf, 2012). Western view of mathematics dominates current mathematics texts, curriculum, and instruction. For example, images, information, examples, depictions, and mentioned contributors of mathematics knowledge are often White Western Europeans. As a result, the rich historical mathematical legacy of Black people around the world, as well as, their contributions to both scientific and natural mathematics are readily absent in mathematics and mathematics education. To challenge Western views of mathematics that minimize Black people from the history of mathematics, I highlight some of the mathematical contributions that Black people made around the world (see Appendix A). This is not an exhaustive list of contributions but it begins to tell a wider narrative of Black mathematicians from Africa, the Americas, Asia, Europe, and around the world who have contributed to their respective fields in mathematics. Therefore, it's intended to be viewed as an introduction of the many mathematical contributions that Black people made throughout the African diaspora. In addition, the contents in Appendix A can help to dispel any myths that render Black people as mathematically inept, by showcasing past contributions, and suggesting potential for extraordinary promise.

**Current mathematical operating systems for Black children in the U.S.** From a historical perspective on the mathematical contributions among Black populations of people to a more contemporary concern regarding U.S. mathematics education of Black children, research shows that U.S. mathematics education of Black children has been overtly marked by cultural oppression and cultural unresponsiveness (Greer, Mukhopadhyay, Barber, & Powell, 2009). Today, cultural oppression and unresponsiveness in mathematics classrooms (Jett, 2013) is arguably one of the major causes of race based disparities in school discipline (George, 2015). The link between teachers' cultural unresponsiveness in mathematics classrooms of Black children that lead to high expulsion rates and limited access to rigorous mathematics is problematic (Cheema & Kitsantas, 2014; Noltemeyer, Ward, & Mcloughlin, 2015). Culturally unresponsive mathematics teachers are more likely to have negative teacher-student relationships (Battey, 2013; Martin, 2013; Spencer, 2009). Negative teacher-student relationships lead to higher student infractions, discipline referrals, and expulsion in U.S. classrooms (Simmons-Reed & Cartledge, 2014). Within mathematics classrooms, Black children are three times more likely to receive disciplinary action than White students, who commit similar infractions (Gregory et al., 2016). On average, less than 5% of White students are suspended, compared to more than 16% of Black students (Office for Civil Rights, 2014). Increased student infraction and expulsion decrease student access to mathematics content and lead to limited access to rigorous mathematics courses as further consequences of infractions (Battey, 2013). Students with limited access to advance mathematics courses and who are placed into less rigorous mathematics courses at the onset of their mathematics academic career often remain in similar tracks throughout their K-12 school years.



The practice of tracking Black children into less rigorous mathematics courses based on discipline referrals, ultimately leads to underrepresentation in rigorous mathematics courses, and overrepresentation in special education programs (Ford & King, 2014). For example, in public schools across the nation, Black children represent less than 10% of the overall talented and gifted mathematics education programs for advanced classes (Ford, 2014), but make up more than 33% of students who are labeled mentally retarded or cognitively disabled (Ford & King, 2014). If mathematics teachers remain culturally unresponsive to Black children, their access to rigorous mathematics will continue to diminish. With restrictions to rigorous mathematics courses, Black children are then left with subtractive mathematics learning experiences. Culturally unresponsive mathematics teaching also leads to deprived access to academically stimulating mathematics curriculum and instruction (McDaniel & Kuehn, 2013), which limit opportunities for Black children to engage in future careers in mathematics, mathematics education, engineering, computer sciences, and business ownership to name a few.

On the other hand, there are significant findings from a wide range of studies (Bonner, 2014; Harding-DeKam, 2014) that substantiate culturally responsive mathematics teachers of Black children as an important factor in Black children's success in mathematics. Culturally responsive teachers of Black children build positive relationships with their students, are least likely to have conflictual relationships that lead to expulsion from schools, and are more likely to advance the learning of Black children into more rigorous mathematics courses (Battey, Neal, Leyva, & Adams-Wiggins 2016; Bonner, 2014; Jett, Stinson, & Williams, 2015). Through culturally responsive practices and positive relationships successful mathematics teachers of Black children maintain high expectations of their students, foster essential skills, and build critical per-

spectives and critical understanding (Ford, Henfield, & Scott 2013). Culturally responsive mathematics teachers view mathematics as socially constructed and influenced by culture (Bonner, 2014; Ladson-Billings, 1994; Nieto, 2010) thus making the incorporation of their students' cultural referents as expectations in their mathematics classrooms. Recognizing mathematics as socially constructed and influenced by culture underscores the importance of my study, which is to examine how preservice secondary teachers negotiate their experiences using culturally responsive mathematics pedagogy to teach mathematics.

Another persistent problem is that Black children continue to receive culturally biased curriculum and instruction that many researchers attribute to the low achievement of Black children in mathematics (Bonner, 2014; Leonard & Martin, 2013; Huber, 2014). To illustrate the problem of low mathematics achievement and cultural incongruences within U.S. schools I will discuss the following: 1) Black children's low achievement in secondary mathematics and, 2) secondary mathematics teachers' lack of commitment to use culturally responsive mathematics instruction, which is a contributing factor in the low achievement of Black children in secondary mathematics.

**Low achievement in mathematics for Black children.** Researchers have found that students' learning outcomes are determined in large measure by the nature of their learning experiences (Prime & Miranda, 2008). The negative learning experiences that Black children face in the U.S. K-12 mathematics classrooms account for their low mathematics achievement (Bright, 2016; Hubert, 2014). According to the National Assessment of Educational Progress (NAEP) mathematics report, in 2013 at the 12<sup>th</sup> grade level, 61% of Black students scored below basic levels in mathematics; 31% at basic grade level, while only 7% scored at the proficient level (NAEP, 2013). In 2015, NAEP mathematics report showed that at the 12<sup>th</sup> grade level 64% of

Black students scored at the below basic level; 29% scored at basic grade level, and only 7% scored at the proficient level (NAEP , 2015). These NAEP compiled test result data is undeniably disturbing. However these mathematics percentage achievement scores of Black children as a whole, result from inequitable school practices and policies which limit Black children to low quality instruction (Ford, Trotman, Moore, & Amos, 2013) and involve culturally biased curriculum and instruction (Rector-Aranda, 2016), as well as unsupportive teacher practices and expectations (Darling-Hammond, 2010; Garcia & Chun, 2016; Landsman, 2004).

Expectedly, mathematics teachers' expectations are instrumental to student learning. Unfortunately, Black children's motivation and confidence in mathematics learning is often damaged with low teacher expectations, which lead to mathematics underachievement (Battey, 2013; Darling-Hammond, 2010; Martin, 200). Compared to other groups, Black children are among most marginalized children who continue to have inequitable access to quality mathematics education, as far as, teacher retention, appropriate funding, challenging academic mathematics programs, and extracurricular mathematics activities as compared to their White counterparts (Bonner, 2014; Darling-Hammond, 2010). Mathematics teachers of Black children are also unresponsive to their diverse home and community culture (Battey, 2013; Bright, 2016). Which contributes to existing inequitable schooling practices such as race-based discipline disparities (George, 2015; Losen, 2013) and limited access to rigorous mathematics courses (Kitchen, Ridder & Bolz, 2016).

Typically, society has held deficit views related to students of color (i.e., Black, Latinos, Native Americans), particularly about who can and cannot do mathematics (Martin, 2009). As a result, only a select few students (e.g., Asians and White males) are challenged in rigorous mathematics (Darling-Hammond, 2010; Lubienski, 2002; Martin, 2013). However, recent research

shows that when mathematics teachers recognize that students bring diverse cultures, acquired from their homes and communities, into the classroom and they structure classroom interaction in ways that allow students to build on prior proficient knowledge (Moll, Amanti, Neff, & Gonzalez, 1992), these same teachers can influence student learning in powerful ways. For some teachers (and students), the medium, through which they have been socialized about mathematics, makes culture matters in mathematics classrooms challenging. Far too many teachers often do not know enough about their students' home cultures (May, 2011), and because culture penetrates home, community, and school life, learning for many students is hindered.

**Secondary mathematics teachers lack of commitment to the use of culturally responsive instruction.** Researchers, examining secondary mathematics preservice teachers' experiences using culturally responsive pedagogy in secondary mathematics classrooms, are needed (Brown, 2004a, 2004b; Reiter & Davis, 2011; Sleeter, 2001a, 2001b; 2005). Some researchers maintain that cultural biases, absence of race consciousness, and attitude (Young, 2010) of preservice mathematics teachers toward the use of students' cultures in the classroom can inhibit the implementation of CRP and can negatively impact the learning of culturally diverse students. According to Jett (2013), secondary mathematics educators at large are not committed to embracing the use of their students' cultural referents as part of the mathematics teaching and learning experiences to create a bridge between school and home life. Education research scholars (Bonner & Adams, 2012; Bonner, 2014; Gay, 2002; Irvine, 2003) maintained that teacher preparation programs are not, with fidelity, incorporating culturally responsive pedagogy in teaching and learning mathematics as part of preparing mathematics teachers for diverse classrooms. As a result, they are likely to prepare unresponsive teachers, who are part of the forces that help to sus-

tain inequitable treatment of Black children in mathematics classrooms. In addition, many preservice mathematics teachers have only a cursory understanding of culturally responsive pedagogy for the mathematics classroom, and their efforts to bridge the cultural gap often fall short (Gay, 2002; Irvine, 2010). Even when teacher preparation programs incorporate diversity classes as a way to focus on CRP within teacher education programs, there appears to be a disconnect and lack of support between what mathematics preservice teachers learn and what their mentor teachers are doing in the fields (Jett, 2012). In sum, far too many preservice teachers are not committed to embracing the use of their students' cultural referents as part of the mathematics teaching and learning experiences. This lack of commitment is often a result of cultural discontinuity between teachers and their students. Cultural discontinuity or cultural mismatch in schools refers, to the lack of synchronization between school norms or culture and student culture (J. Irvine, 2003). Cultural discontinuity with Black children is often a result of institutionally racist beliefs held by teachers about Black families (Puchner & Markowitz, 2015). Cultural discontinuity can produce apathy, academic disengagement, and school discontent (Greer, Mukhopadhyay, Powell, & Nelson-Barber, 2009). On the other hand, cultural responsiveness can prevent cultural discontinuity in schools. Therefore, providing preservice teachers with examples of how to embed culturally responsive pedagogy (CRP) in mathematics classrooms is critical (Leonard & Moore, 2014). Interestingly, culture serves as a medium through which learning can take place (Gay, 2002), and as the percentages of school aged Black children continue to rise while the percentage of White teachers remain relatively steady at 83% or higher, it becomes increasingly unlikely each year that a student will share the same cultural background of his or her teacher (May, 2011). According to Maxwell (2014), for the first time in the history of U.S. public schools, the new collective majority of minority schoolchildren, Black and Latino, is projected to

be 50.3% surpassing the number of White students. This shift in demographics, poses a plain imperative for public schools and society at large (Maxwell, 2014). Mathematics teachers are critical to successful student learning of mathematics so teachers need strong grounding on how to teach culturally diverse students using CRP.

### **Purpose and Research Questions**

The purpose of my study was to examine how preservice secondary mathematics teachers (PSMTs) negotiate their experiences using culturally responsive mathematics pedagogy (CRMP) (e.g., culturally responsive pedagogy in teaching and learning mathematics) to teach mathematics during their practicum. In other words, I examined the preservice teachers' experiences as they conducted practical work in the teaching and learning of mathematics using CRMP practices during the beginning part of their program and within their assigned mathematics classrooms. Coupling qualitative research methodology and critical race theory, I examined PSMTs experiences and afforded each of them with opportunities to explore their experiences by addressing racial, socio political, and cultural issues within mathematics education. In this study, I examined the following research questions:

1. How do preservice secondary mathematics teachers (PSMTs) negotiate their experiences of teaching mathematics to Black children while immersed in culturally responsive mathematics pedagogy (CRMP) professional learning activities during their practicum?
2. What affordances or constraints do PSMTs identify when using culturally responsive mathematics pedagogy?

## **Significance of Study**

In discussing the significance of this study, I will focus on the both its theoretical and practical significance. The theoretical significance of my study lies in the fact that the participants, context, content, conclusions, and implications of the study make it possible to address the need to better prepare PSMTs for CLD classrooms. The theoretical model of CRMP addresses teachers' responsiveness to students in their mathematics classrooms and provide guidance to teacher preparation programs and educators as part of their efforts towards reaching and teaching CLD students (Bonner & Adams, 2012; Hernandez, Morales, & Shroyer, 2013; Leonard, 2008). The current model of CRMP used in this study provide PSMTs with ideologies and practices of culturally responsive pedagogues. Thus, this study could also resolve theoretical questions surrounding CRMP practices in secondary level mathematics and could provide an understanding of the impact of preparing culturally responsive mathematics pedagogues.

Furthermore, this study could support assertions that the use of CRMP is a viable option for teaching Black children mathematics (Bright, 2016; L. Waddell, 2014), and help to identify the different affordances and constraints teachers face when venturing to become cultural pedagogues. This would expectedly heighten the awareness of the teacher educators and educators at large to equip them with ways on how to produce culturally responsive mathematics pedagogues (Jett, 2012) and address constraints as well. More so, this study could demonstrate the usefulness of CRMP as part of educational development of students thereby contributing to the work of addressing the educational needs of CLD students (Battey, 2013; Bonner, 2014). Finally, by examining PSMTs integration and use of CRMP through their reflections and practices, to future researchers this study can provide baseline information on CRMP.

In practical terms the significance of this study begins with fervent support of the assertion that teachers' awareness of distinct cultural capital in classrooms can give teachers considerable power in getting students to learn mathematics in grades K - 12 (Gay, 2000). Therefore, the ultimate goal of an effective teacher preparation program should be to develop and enhance the skills prospective educators require to create learning environments that acknowledge, respect, and are representative of the social world of all students (Noddings, 2012). When teachers create an environment which is based on caring and concern, and in which each student is valued, the result is that students become more motivated and learn more (Stipek, 2006). Culturally responsive pedagogues form caring relationships with their students (Irvine, 2010). Caring and positive teacher-student relationships are important in the social spaces of secondary mathematics classrooms.

My study is probing work needed to help teacher preparation programs prepare more culturally responsive mathematics teachers. Culturally responsive mathematics teachers help to sustain positive teacher-student relationships. These positive teacher-student relationships can lead to less conflict in mathematics classrooms. Positive mathematics classroom environments support academic learning, and ultimately help to reduce discipline disparities and race-based academic tracking. In addition, understanding the experiences of PSMTs not only assist teacher preparation programs in preparing more culturally responsive mathematics teachers, but can also help to prevent cultural discontinuity in mathematics classrooms (Gay, 2002; Oliver & Oliver, 2013).



## **Definition of Terms**

Affordances: qualities, norms, effects and relations, which support interactions and help determine if and how an individual can enact behaviors within a given context (Gresalfi, Barnes, & Cross, 2012).

Black: of or relating to individuals of African descent; African American; of or relating to the African American people (Tatum, 2004).

Constraints: qualities, norms, effects and relations, which limit interactions and therefore prevent if and how an individual can enact behaviors within a given context (Gresalfi, Barnes, & Cross, 2012).

Culturally Responsive Mathematics Pedagogy (CRMP): is a pedagogy, meaning the art of teaching, that recognizes the importance of including students' cultural references in all aspects of teaching and learning mathematics (Aguirre, & del Rosario Zavala, 2013; Brown-Jeffy, 2009; Hernandez et al. 2013, Morales, and Shroyer, 2013; Jackson, 2013; Leonard, 2008; Leonard & Moore, 2014).

Negotiate: find a personal path that leads to a promising challenge that involves using culturally responsive pedagogy for mathematics classrooms to teach Black children.

Preservice Secondary Mathematics Teachers: students in a teacher education program, at a college or university, preparing for professional-level teaching positions, and initial teacher certification.

## **Summary**

Mathematics has become a top priority in U.S. education (Phillips, 2014). As a privileged subject, the mathematics education children receive can set them on pathways for either academic success or social struggles, influencing their achievement trajectories and consequently

their eventual accomplishment (Dunleavy, 2015; Leonard, 2008; Leonardo, 2013; Leonard & Moore, 2014; Martin 2000). Teachers, therefore, serve as essential components to students' success, and need to be exposed to viable options that prepare all children for success in mathematics classrooms as well as promote strong and positive teacher-student relationships. This study examined secondary mathematics teachers' experiences using CRP as a viable option to teach mathematics by focusing on Black children. We need to study Black children because far too many Black children are not finding success in mathematics classrooms. Clear evidence exists that overall, the academic needs of Black children are not being met in mathematics classrooms as compared to other groups due to being unfairly and unjustly targeted within schools. For example, Black children make up only 16% of the U.S. school population yet over 30% of school expulsions; over 33 % of special education student population; less than 10% of the overall mathematically gifted student population; less than 15% gifted/honors/AP mathematics student population; account for the least academic gains; account for the most U.S. incarcerations; are victims of race based discipline disparities and unfair academic tracking; and are more likely to be expelled from U.S. schools than any other group (Barton & Nishioka, 2014; Ford & King, 2014; Jackson & Howard, 2014; George, 2015; Martin, 2012).

These data tell us that there is something profoundly wrong with the U.S. education system, and we cannot ignore that. That is why this study used PSMTs of Black children to examine their understanding of CRP as a viable option to teach Black children mathematics, and how they use the ideology of CRP in their classrooms. Examining PSMTs use and integration of CRMP to teach Black children is a beginning process to hold teachers accountable for educating Black children. It cannot be overstated that when mathematics educators become responsive to the educational needs of our most marginalized group of Black children then everyone benefits. For the

remainder of this work several major sections will be included. Chapter 2 will review and summarize pertinent research literature directly related to the proposed study. Central to the discussion in chapter 2 is the theoretical framework that governs this study, identifying culturally responsive pedagogy for mathematics as a viable tool for teaching and understanding mathematics, and the importance of understanding the experiences of teachers who venture to adopt culturally responsive mathematics practices. This is followed by chapter 3, which focuses on the methodology of the study. Within this chapter, the study's data collection and analysis process are all described and discussed in detail. Chapter 4 discloses the findings of the study. Lastly, chapter 5 discusses the study's findings, connects the emerged themes to literature, discusses implications of the study's findings with recommendations, and provides a final thought.

## **CHAPTER 2 REVIEW OF THE LITERATURE**

In this study, I closely examined the experiences of four preservice secondary mathematics teachers (PSMTs) as they negotiated their experiences teaching mathematics to Black students while immersed in culturally responsive mathematics pedagogy (CRMP) professional learning activities. What follows is a literature review that focuses on five areas of scholarship that guided my study with the participants described above.

The first section of my literature review discusses the theoretical lens used to assist me in answering the research questions. According to Crotty (1998), theoretical framework in research studies is a philosophical stance, which helps to provide context for research processes and helps to ground the research logic and criteria. As such, theoretical frameworks build, identify, and describe major elements, variables, and constructs that organize research studies (Ennis, 1999). The theoretical lens of critical race theory was used in this study to highlight the stories about PSMTs experiences, to provide new insights, and to broaden my understanding of PSMTs experiences. In addition, a discussion of my theoretical framework is appropriate because the lens of my theoretical framework emerged from my research focused on CRMP and guided my study's design which is found in the next chapter.

The second section discusses CRMP by exploring the historical and current foundations of CRMP as a viable option for teaching mathematics to Black students. Building more on chapter one and with more detail information, I start this first section with a brief history of how education scholars, past and present, encouraged the use of children's' social or cultural experiences to better teach them. Afterward discussing the history and foundations of CRMP, I define what

CRMP is for this study and mathematics classrooms. Varying models of CRMP are also discussed followed by a discussion regarding the need and implications for CRMP in secondary level mathematics classrooms.

The third section of my literature review contains an examination of empirical studies that focus on the use of CRMP in mathematics classrooms. Throughout this section of the literature review, I concentrate on empirical studies that investigate both preservice and in-service teachers' experiences using CRMP as their instructional framework. First, I examined affordances of teachers who infused CRMP as part of their mathematics teaching practices, followed by an examination of constraints placed on teachers when attempting to incorporate CRMP as part of their mathematics instructional framework,

The fourth section discusses major gaps and limitations that I determined within the reviewed literature. Identification of gaps and limitations of studies can lead to further investigation, clarity and deeper understanding of theories and concepts. Within this section, I also identified ways in which my study addressed each identified gap.

### **Theoretical Framework**

The examination of PSMTs experiences, or any of their identified affordances and constraints using CRMP to teach diverse students can be part of a larger examination of educational norms, and beliefs that contribute to the subordination of certain racial groups (Solórzano & Yosso, 2002) . Such experiences, being complex and occurring at the intersectionality of race and culture, requires a theoretical framework that challenges dominant social and cultural assumptions regarding culture, intelligence, language, and capability. Critical race theory (CRT) provides researchers with a framework to challenge dominant discourse on race, racism, and cul-

ture as it relates to education by examining how education theory and practice are used to downgrade certain racial and ethnic groups (Solórzano & Yosso, 2002). CRT is a theory used by those who challenge inequitable situations (Crotty, 1998) such as genetic and cultural deficit theories about students of color (Solórzano & Yosso, 2002). Historically CRT was a response to the limitations of the critical legal studies (CLS) movement (Delgado & Stefancic, 2001), and has been used to address issues of race and race relations in the U.S. and more recently its education system. CRT in teacher education seeks to identify, analyze, and transform subtle and overt practices of inequalities within the education system by addressing how educational structures, processes, and discourses function to maintain unequal treatment of students of color (Solórzano & Yosso, 2002). Tenets of CRT include:

1) Racism as normal in American society. Supporters of CRT use this tenet to assert that racism is normal, not aberrant, in American Society (Bryant, Moss, & Zijdemans Boudreau, 2015). Racism as a usual way society does business makes it a common everyday experience of most people of color. Racism in the U.S. typically occurs when any program, or person practices discrimination, or mistreatment against other people that are members of a particular race or ethnic group (Delgado & Stefancic, 2001).

2) Use of storytelling and counter storytelling to dispel myths and discourse that renders people subordinate. Storytelling is used to dispel myths and discourse that renders marginalized groups subordinate. One of the main methodological tenets of CRT is personal narratives or storytelling. Personal stories or narratives recount an individual's experiences (Delgado, 1989). Often, these personal stories are autobiographical reflections of the author, compared with their critical race analysis and within the context of a larger sociopolitical account (Solórzano &

Yosso, 2002). Stories create their own bonds, represent cohesion, shared understandings and remind us of our identity related to other groups (Delgado, 1989).

3) The dominant culture does not fully understand what liberty and equality are. Supporters of CRT critique ‘liberalism’ by arguing that the dominant culture does not fully understand what liberty and equality are, and rejects the notion of colorblindness, the neutrality of law, and incremental change (Bryant et al., 2015). Essentially, liberalism rejects race based arguments even to remedy historical wrongs. However, supporters of CRT contend that only aggressive color consciousness can ameliorate racial disparities (Delgado & Stefancic, 2001).

4) Interest convergence theory. Supporters of CRT maintain that the majority group, those that are in control of social, and political issues, tolerates advances for racial justice only when it suits their interest to do so (Bryant et al., 2015).

As a product of the legal studies movement of the 1970s (Closson, 2010), CRT theorists seek to liberate, empower, and promote justice (Delgado & Stefancic, 2001). With regards to education, CRT challenges dominant notions and discourses in education through rich and deep deconstruction of racist policies and procedures (Ladson-Billings & Tate, 1995). Within this proposed study, specifically during readings and discussions, I wish to create a space for PSMTs to discuss culture, race, and racist policies in education. Such discussions are necessary for preservice teachers to take a critical approach to race and to explore ways in which both racial and cultural diversity can be honored in the classroom (Buchanan, 2015; Sleeter, 2001a; 2001b). Next is a brief discussion of the theoretical appropriateness of CRT for the current study.

**Theoretical appropriateness of critical race theory for this study.** CRT is an appropriate theoretical framework for this study. Using CRT tenets in this study helped me to situate

PSMTs experiences teaching diverse children, and assisted me in leading inquiries, conversations, and discussions pertaining to race, culture, and diversity issues as found in the U.S. education system. It is important to discuss race and culture together because as it stands within U.S. society, race affect various domains of people's lives including but not limited to how they live (Nasir, 2016). Race impact the type of jobs people have, the amount of money they make, the kinds of friends they have, the places they like, the foods they eat, as well as the schools they attend etc., which are all cultural phenomenon (Marrus, 2015). Theoretically, CRT in education, helps to establish lens that would support the need for preservice teachers to become more conscious of their culture and the social culture around them (Cerezo, McWhirter, Peña, Valdez, & Bustos, 2014). There is a need for preservice teachers to embrace culture as a living entity (Bryant et al., 2015). Solórzano and Yosso (2000) explained that CRT in relation to education help to frame pedagogy that can be used to challenge and transform aspects of education that maintain the marginalization of students. Researchers using CRT can examine issues of race, culture, language, identity, diversity, and inequities in education (Ladson-Billings & Tate, 1995). A better understanding of these issues and how they relate to racial inequities is both crucial to the development of sociocultural awareness and plays an intricate role in the foundation for culturally responsive dispositions and practices (Wallace & Brand, 2012). The ideologies of CRT can be used in education to identify how teachers engage in meaningful race related conversations that lead towards creating more equitable and just school experiences for diverse children (Solórzano & Yosso, 2002).

CRT as a framework contributes to qualitative research in that it allows the researcher to stand in a different relationship to both the research and researched (Ladson-Billings, 2000). A critical race theory methodology in education acknowledges and recognizes multiple layers of



oppression, discrimination, and subordination based on race, gender, class and other discriminatory practices (Solórzano & Yosso, 2002). CRT methodology in education recognizes and challenges white privilege, traditional research paradigms, texts, and theories used to explain the experiences of people of color (Solórzano & Yosso, 2002).

In addition, using a critical race theory framework for this study may assist preservice teachers in identifying and disrupting racial and cultural misinformation that are factors in the creation of current oppressive forms of education (Larnell, Bullock, & Jett, 2016(, #459@@hidden)). For example, in this study CRT tenets were used to help identify whether secondary level mathematics children's racial identities influence preservice teachers' beliefs, perceptions, and practices about using culturally responsive mathematics. CRT tenets will help to identify, if any, conditions and experiences surrounding preservice teachers of diverse students that might be racially situated (Wallace & Brand, 2012). Further, these tenets will assist me in analyzing preservice secondary mathematics teachers' experiences using culturally responsive mathematics, and allow me to draw larger implications of PSMTs experiences. Next, I discuss the foundations of culturally responsive mathematics pedagogy (CRMP) and its conceptual ideologies and practices as a viable option for teaching mathematics in diverse classrooms.

### **Culturally Responsive Mathematics Pedagogy (CRMP)**

Before the landmark case of *Brown vs. Board of Education* in 1954, segregation of U.S. public schools ensured that the educational needs and cultural issues of diverse children were of marginal interest to White educators (Schmeichel, 2012). Therefore, in order to understand how culturally responsive teaching emerged as a viable teaching practice, it is necessary to examine schooling practices in the United States (U.S.) during pre- and post- segregation eras and understand why and how it came to be possible to think of some children as culturally different. What

follows is a brief discussion about the historical and current context for CRMP as it relates to the mathematical schooling experiences of Black children in the U.S.

**Historical and current contexts for CRMP.** The exploration of the purpose and importance of schooling in the U.S. extends to the beginning of its first public education system. The first public secondary or high school in the United States (U.S.) was created in 1820. In 1892, the Committee of Ten who were all White male members of the National Education Association (NEA) of the United States argued for teaching methods that were not only objective but also build on students' mental activities and environment. Specific to mathematics, The Committee of Ten, as they were called, opined that mathematics curriculum, and instruction should be subordinate to the living teacher (NEA, 1892). In other words, teachers should support their mathematics teaching instruction by drawing upon objects of familiarity or life experiences of their students. According to the Committee of Ten arithmetic and geometric concepts in mathematics should be "abridged by omitting entirely those subjects which perplex and exhaust pupils without affording any really valuable mental discipline" (p. 23), and should "extend to practical applications" (p. 24) as well as "make new applications to familiar principles" for students (p. 25).

During this time, only White male children and White children of landowners could attend school, and the Committee's primary concern regarded only the education of this population of students. The Committee asserted that the instruction of mathematics should be objective, textbooks should be subordinate to the living teacher, and illustrations and mathematic problems should be drawn from familiar objects to students. Despite its primary focus on White male land owners, the Committee's call for teacher instruction to be based on the personal experiences of students—experiences that draw from students' mental and environmental activities—suggest

that the founding fathers of the U.S. education system supported an ideology centering curriculum and instruction on children's life experiences and deemed such experiences as important factors in student learning.

Later, in 1918 the NEA, through the Cardinal Principles report, suggested that a responsive curriculum was one that stood squarely for the infusion of vocational schooling and with the spirit of service to the world. The Cardinal Principles laid out by the NEA articulated that success of school systems depended on how convinced students were that what they were learning was not only necessary knowledge, but also knowledge that would serve them and their community. In other words, students' identification with curriculum should come through meaningful and responsive teacher instruction so that the knowledge gained would be useful to their communities.

As the years rolled on, more education scholars (e.g., Addams, 1961; Counts, 1932; Dewey, 1938), expanded who were included in the education process to include White females and middle class White students and began to argue in support of curriculum and instruction that were adaptive to students' lived experiences through insight into students' capacities, interests, and habits (Randolph, 2008). Counts (1932) whose primary interest was in bridging the education gap between upper and middle class White students posited that teacher instruction should not primarily serve the interests of the ruling class but should be considered as a social responsibility of that teacher to students. He appealed for teachers to lead the schools and the public forward in what he termed 'social regeneration', which meant to bring about social change. Following Counts, in 1938 John Dewey, who is referred to many in the education world as 'the father of education,' argued that to truly educate students, teachers need to stimulate students' minds in ways that prepare them to challenge social situations (Dewey, 1938). He designed a problem-

based inquiry learning system that suggested teachers attend to students' questions and prior knowledge to construct meaning rather than rely solely on teacher based lesson plans, which in terms of exploring mathematics meant that sensing value and truth was part of problem solving strategies (Dietiker, 2015). Ultimately, these educational scholars suggested that the learning environment in which teachers and students engage needs to be situated in the social realities of students. Students should be allowed to impact their own learning through a self-creating process within their environment. This would require various adaptive teaching and learning models that respond to the need of students instead of a 'one size fits all' prescriptive approach to teaching and learning.

By 1961, more scholars began to reject the 'one size fits all' curriculum and instruction in schools and called for provisions of choice that helped to curtail teacher instruction to specific students in their classrooms (Addams, 1961). However, the previous reforms were not for Black children. The primary intent of many of these early scholars' suggestions of curriculum and instruction reforms was to protect White children. Nonetheless, the suggested reforms also led to increased challenges of what it meant to effectively teach children of color such as Black and Latino children so that the life experiences of these children were not ignored in the classroom. While the 'founding fathers of education' focused squarely on the needs of White children, the fight for the right to an education for students of color, in particular Black children, would not come easy.

For African Americans living during the early 1800s school was synonymous with emotional, mental, and later physical freedom. During this era, many Southern laws such as the one passed in 1831 by the Mississippi legislation, prohibited African Americans from reading, writing, and learning (Beyer, 2014; Cobb, 2014; Rucker & Jubilee, 2007), therefore, obtaining a U.S.

education had to be covert. In secrecy, and to avoid harsh punishment and or possibly death, many African Americans started underground resistance movements. The early stages of these underground resistance movements started with a free African American woman named Mary Peake who secretly taught many physically enslaved African Americans how to read and write underneath an oak tree in Hampton, Virginia (Cobb, 2014).

Once the secretive resistance movements grew and social and political changes began to impact U.S. education policies covert movements eventually led the way to the formation and creation of the first public schools for African Americans in 1871 through Reconstruction legislatures of the South (Graff, 2016). Unfortunately, the creation of public schools for Black children would not mean equitable educational services. First public schools for African Americans were at the mercy of White-controlled government funding and operated under a U.S. education system that was separate and unequal. This meant the schools' funding for curriculum and instructional supplies rested squarely on the compassion of White officials. Consequently, because many Whites believed that educated African Americans would challenge White supremacy and not be content with mediocre jobs and domestic service Black schools received far less financial support than did White schools, had fewer books, worse buildings, and less well paid teachers (Hunter, 2015). In the era between 1877 and 1901, Southern legislators, lynch mobs, the Ku Klux Klan, and even the U.S. Supreme Court rolled back years of progressive change for Blacks that occurred during Reconstruction (Rucker & Jubilee, 2007). The end of the Reconstruction era saw continuous social, political, and economical ideological shifts in the U.S. including shifts in ways to educate children, in particular culturally diverse non-White children. As Reconstruction ended, science, industry, and transportation made strides. A new era known as the period of Industrialism dawned upon the U.S.

During the early 1900's the United States experienced new grounds in industrialism (Leonard & Martin, 2013). This new industrialism placed demands on schools, influencing what should be taught and how it should be taught (Beyer, 2014). For example, in this period mathematics subject contents focused primarily on mathematics used in the everyday work requirements of adults and was geared toward productivity in various industries such as agriculture, mechanics, carpentry, and factory systems (Seaton, 2014; Snyder, 2015). The intent was to prepare skilled workers, and labor ready children to work in factories. The new industrialism also required workers to have minimum elementary grade competencies, and compulsory school attendance (Snyder, 2015). Although the primary intent of the compulsory school attendance was to protect White children, there were an increase in school attendance for Black children, which led to an increase in Black schools (Seaton, 2014).

During this new industrialization period of the 1900-1940s, the overall new focus was to prepare labor ready U.S. citizens for skilled jobs. The primary interest in educating Black children was to produce workers for the U.S. industries and factories (Rucker & Jubilee, 2007). It was during this period of industrialization that the emergence of prominent education leaders and activists such as Booker T. Washington and W.E.B. DuBois occurred (Leonard & Martin, 2013). Booker T. Washington and W.E.B. DuBois, advocated for Blacks gaining economic stability and self-sufficiency through education (Ani, 2013). Specific to mathematics, Booker T. Washington focused on learning that connected to the lives of Black children at the vocational level (Leonard & Martin, 2013). His vision for the role of mathematics education of Black children included a balance of knowing rigorous mathematics topics and vocational, everyday ideals (Berry, Pinter, & McClain, 2013). In contrast, DuBois sought to prepare Black children to challenge the world (Leonard & Martin, 2013). He disagreed with Washington's assertion to primarily prepare Black

children for vocations and industries, but instead called for mathematics education to prepare Black children for the rapidly changing world (Berry, Pinter, & McClain, 2013). DuBois viewed mathematics teaching for Black children as preparing Black children to be thinkers and for them to use mathematics to critique the world in which they lived (Leonard & Martin, 2013; Ani, 2013). Despite their different approaches, both Washington and DuBois understood the value of education for Black children. Both supported mathematics curriculum that prepared Black children to meet the needs of their communities and viewed education as a move toward liberation.

Turning to education, for African Americans, was a deliberate strategy to combat the messages of inferiority in larger society (Banks & Banks, 1995). Post new industrialism era, during the 1940s and 1950s, the primary focus of African American education addressed Black pride and nationalism whereby African Americans worked toward creating supportive school environments as they concentrated on empowerment and advancement of the Black race. The goal of education for Black children was centered on teaching self-pride and determination in order to challenge racial and cultural disparities in society (Ani, 2013). This approach to education is referred to by scholars as the Early Ethnic Studies Movement (Banks & Banks, 1995) which include teaching about the struggles of culturally diverse groups. Although Ethnic studies were proposed since the late 19th century by education scholars such as W.E.B. Du Bois and José Martí, it was not accepted in mainstream academia (Chung & Harrison, 2015; Wanberg, 2013).

Early Ethnic Studies is a critical and interdisciplinary study of race, ethnicity, and indigeneity with a focus on the experiences and perspectives of people of color within and beyond the U.S. (Chung & Harrison, 2015). Ethnic Studies explore race and ethnicity across all disciplines in order to address issues of Eurocentrism, oppression and identity (Ani, 2013; Banks, 1995). Like culturally responsive pedagogy, Early Ethnic Studies was designed to combat historical

practices and policies that sought to provide little to no educational opportunities for children of color, or policies and practices that prepared culturally diverse non-White children with industrial skills (Beyer, 2014). For example, at the onset of U.S. public schools in the early 1800s, Black children were not allowed to attend schools or be educated while U.S. education for non-White Native Americans was designed to convert Native Americans to Christianity, train them to become missionaries, and produce laborers (Beyer, 2014). Furthermore, mathematics was not part of the curriculum for Native American children and only included reading, writing, arithmetic, English, Greek, and Latin with a manual labor system that consisted of doing work around school grounds (Meza, 2015). In recent years, discussions about best practices for educating culturally diverse children in the U.S. have undergone meaningful changes. Education scholars have since recommended multicultural education (Nieto, 2000; Sleeter, 1989) culturally relevant pedagogy (Ladson-Billings, 1995a), and culturally responsive pedagogy (Gay, 2000) as a way to meet the academic needs of all students.

Culturally responsive pedagogy is founded within critical theory and critical pedagogy (Ladson-Billings, 1998; Ladson-Billings & Tate, 1995) traditions. Culturally responsive pedagogy as part of critical pedagogy (Ladson-Billings, 1995a) (Freire, 2000) is grounded in ideologies and practices that seek ways in which teachers might teach and students might learn to often further social justice and equality through teaching and learning (Freire, 2000). Particularly concerned with the intersectionality of schooling and culture Ladson-Billings (1995b) conducted a study whereby she observed the practices of eight exemplary mathematics teachers of African American students. She used their practices and her reflections on those practices to propose theories of culturally-focused pedagogy as part of the reformation of teacher education. In her discussion about culture and education, Ladson-Billings argued that most practices in schools that



serve children of color do not consider and make the most of the rich cultural capital Black children bring to the teaching and learning process in order to make learning successful. Ladson-Billings suggested that what is needed is culturally relevant pedagogy that require the utilization of student culture as a vehicle for learning.

Concerns about developing a closer fit between students' home culture and school education were also voiced by other education scholars. For example, in an article drawing from a book written for preparing culturally responsive teachers, Gay (2002) described culturally responsive pedagogy as containing five essential tenets, which are:

1. Teachers develop a knowledge base about cultural diversity, including ethnic and cultural diversity content in the curriculum
2. Teachers demonstrate care
3. Teachers build learning communities
4. Teachers communicate with ethnically diverse students
5. Teachers respond to ethnic diversity in the delivery of instruction

Ladson-Billings (1995a) and Gay (2002)'s calls to push teacher preparation programs to produce culturally responsive pedagogues reflect a consistent pattern in scholarships that seek to improve the school success of diverse students. Overall, culturally responsive pedagogy is highly encouraged and minimally critiqued in the reviewed literature. However, in offering an alternative to culturally responsive pedagogy, the most prominent critique comes from educational scholar Django Paris. In re-thinking culturally responsive pedagogy both in theory and practices and in the spirit of renewing teachers' commitments to affirm students racial, cultural, and ethnic identities, Paris (2012) proposed culturally sustaining pedagogy. Culturally sustaining pedagogy "seeks to perpetuate and foster—to sustain—linguistic, literate, and cultural pluralism as part of

the democratic project of schooling” (p. 93). For Paris, culturally sustaining pedagogy as a resource pedagogy offers an alternative to culturally responsive pedagogy given its focus on multiethnic and multilingual present and future (Paris, 2012). Nonetheless, considering Paris’ alternative toward embedding culturally responsive pedagogy in teaching and learning with multiethnic and multilingual tenets, the critical question becomes does culturally responsive pedagogy add more to the education community?

Culturally responsive pedagogy uses a theoretical framework based on critical race theory to synthesize race, culture, and education matters (Ladson-Billings, 1998), and is an intricate part of current reform efforts to improve teacher education programs through commitments to social justice and equity for all (Villegas & Lucas, 2002). Moving toward equitable instruction is highly critical at a time where historically underserved populations are still not achieving to levels of their potential. Culturally responsive teaching involves teaching from the cultural experiences of students (Gay, 2000; Ladson-Billings, 1995), and is applicable to all subject areas. However, for purposes of this study, I will focus only on culturally responsive mathematics pedagogy for the secondary mathematics classrooms. What follows is a brief definition of what culturally responsive mathematics pedagogy (CRMP) is as well as highlights of some basic models and tenets of CRMP that are important to this study.

**Definition and constructs of CRMP.** Research on the use of culturally responsive pedagogy in K-12 mathematics classrooms highlight importance aspects of teaching that includes teaching students for: a) understanding of mathematics; b) building awareness of students’ cultures; c) centering instruction around students’ experiences; d) developing students’ critical consciousness with and about mathematics; and e) building relationships with students (Bonner &

Adams, 2012; Rubel & Chu, 2011). These aspects of culturally responsive mathematics pedagogy such as building relationships with students and developing their critical consciousness help to empower students intellectually (Timmons-Brown & Warner, 2016). CRMP for this study is based on a model from Hernandez, Morales and Shroyer (2013) and extends the previously mentioned aspects of culturally responsive teaching to include: a) content integration; b) facilitating knowledge construction; c) prejudice reduction; d) social justice; and e) academic development (see Appendix B).

Additionally, within culturally responsive mathematics classrooms, teachers seek to: (a) establish connections between children to help them in becoming critical mathematical thinkers who view knowledge critically; (b) facilitate knowledge through established connections that require building on students' out of school mathematical knowledge, including cultural knowledge, and experiential knowledge; and (c) develop positive orientations to students' culture and experience (Aguirre, & del Rosario Zavala, 2013; Brown-Jeffy, 2009; Hernandez et al. 2013, Morales, and Shroyer, 2013; Jackson, 2013; Leonard, 2008; Leonard & Moore, 2014). These three constructs, i.e. critical mathematics thinking, knowledge facilitation and orientation to student's culture are embedded in culturally responsive mathematics classrooms. The next three paragraphs provide explanations of each construct.

***Critical mathematical thinkers.*** According to Aguirre, & del Rosario Zavala (2013), teachers who engage in culturally responsive pedagogy for mathematics classrooms are distinct in that they inculcate critical mathematics teaching in their dispositions and practices which in turn foster critical approach to knowledge acquisition. CRMP teachers help students question the perspectives of others, and encourage critiques of mathematics practices (Gutstein, 2012). Critical mathematics is evident in teachers' everyday relationships with their students and in their

teaching practices (Bonner & Adams, 2012). CRMP teachers are aware that critical thinking students can be active conscious participants in society so they incorporate critical thinking skills as part of their teaching framework to help students critique knowledge and society (Sleeter, 2011).

***Knowledge facilitation.*** Ladson-Billings (1995b) posited that teachers using CRMP in their classrooms use students' current knowledge to build more knowledge. Teachers need to understand that students are not empty vessels and that diverse children's knowledge and culture are valuable sources that can add to classroom knowledge (L. Waddell, 2014). Diverse children come to school with rich cultural and experiential knowledge, talents, and strengths that can be foundations for furthering their learning (Jett, 2013). Teachers using CRMP engage in knowledge facilitation by activating students' prior knowledge and helping students to make connections from their culture to classroom mathematics content (Ladson-Billings, 1995b).

***Orientation to student's culture and experience.*** Gay (2002) asserted that teachers who consistently and positively position their mathematics instruction toward students' culture and experience help create conditions for students to become social agents of change. As part of being culturally responsive in mathematics classrooms teachers, empower students with knowledge, skills, and dispositions needed to create democratic communities (Tutak, Bondy, & Adams, 2011). Thereby enabling students to become social agents of change. Culturally responsive mathematics oriented teachers, while establishing good rapport with students, go beyond traditional boundaries and provide academic challenges for students (Bonner & Adams, 2012). In addition, culturally responsive mathematics teachers understand that culture is not fixed. Therefore, culturally responsive mathematics teachers help students use mathematics to shape and evolve their students' own realities (Wager, 2012). One goal of a culturally responsive mathe-

mathematics teacher is to help students develop strengths and move beyond limitations to develop cultural excellence (Ladson-Billings, 2009). Unsurprisingly, there are no quick and simple solutions, no single program or packaged intervention to train teachers to teach culturally diverse students, and because of the complexity of the issue and because of the individual needs, motivations, experiences, and abilities of diverse children (Irvine, Armento, Causey, Jones, Frasher, & Weinburgh, 2000) varying models of CRMP exist. The next section describes some of the different models of culturally responsive mathematics pedagogy, and highlights the model that is used in this study.

**Models of CRMP.** Culturally responsive pedagogy is a socially constructed concept that seeks to respond to both community and classroom environments. Varying teaching models of CRMP are available for mathematics teachers who seek to become culturally responsive in their teaching. Thus, teachers have flexibility in choosing how to use students' cultural experiences in the classroom. As a result, culturally responsive pedagogy can vary in its application (Brown-Jeffy & Cooper, 2011). Culturally Relevant Mathematics Pedagogy (CureMap), and Culturally Responsive Mathematics Teaching are two common models of CRP used in mathematics classrooms (see Table 1). Grounded in some constructs of CRMP (such as students' critical consciousness, academic achievement, and cultural competence) the models highlighted in Table 1 provide teachers with effective ways of infusing CRMP within mathematics classrooms.

Table 1

*Varying Models of Culturally Responsive Mathematics Pedagogy.*

Model	Name(s) of Scholar	Year	Tenets of the Model
Culturally Relevant Mathematics Pedagogy (CureMap)	Laurie H. Rubel and Haiwen Chu	2011	Teaching Mathematics for Understanding Center Instruction on Students' Experiences Develop Students' Critical Consciousness with or about mathematics
Culturally Responsive Mathematics Teaching (CRMT)	Emily P. Bonner and Thomasenia L. Adams	2012	Communication Knowledge Trust/Relationships Constant Reflection/Revision
Culturally Responsive Science and Mathematics Teaching (CRSMT)	Cecilia M. Hernandez, Amanda R. Morales and Gail Shroyer	2013	Content Integration Facilitating Knowledge Construction Prejudice Reduction Social Justice Academic Development

Rubel and Chu's (2011) CureMap model of CRMP provide teachers with a model that centers mathematics on students and develops students' critical consciousness about and with mathematics. Bonner and Adams (2012) CRMT model views teacher knowledge, teacher communication with students, and teacher relationship and trust with students as cornerstones of student's learning and academic success. Hernandez, Morales, and Shroyer (2013) CRMT model considers the dispositions and teaching performances that become what teachers do and think. Their model provides teachers with a tool for self-analysis of mathematics instruction and assessment for culturally responsiveness. Thus, teachers are able to examine and reflect on their own teaching practices. According to Hernandez et al. mathematics teachers who embrace CRP as a teaching framework incorporate tenets of CRP that include content integration, facilitating

knowledge construction, prejudice reduction, academic excellence and social justice in their mathematics classroom. Next I will discuss the culturally responsive mathematics teaching model that will be used in this study, and its alignment to the National Council of Teachers of Mathematics (NCTM).

**CRMP model specific to this study.** This study will adapt the CRMP model as prescribed by Hernandez, Morales, and Shroyer (2013), because of its clarity and specificity (see Appendix B). This model embraces a fundamental idea of the pedagogical philosophy of both the National Council of Teachers of Mathematics (NCTM) standards, and the ideologies of culturally responsive pedagogy for the mathematics classroom which supports teachers' need to be well aware of children's knowledge so that they can use it as a starting point from which to build. Further discussions regarding the benefits of using this CRP model as an analytic tool to check teachers' instruction for specific tenets of CRP is discussed in the next chapter.

Clearly, the mathematics experiences of Black children as discussed in Chapter one must change. One general theme that emerged from NCTM 2012 report was that as part of the mathematical learning standards for students, teachers need to help students become mathematically proficient by giving students opportunities to apply mathematics to solve problems arising in everyday life, and society. Moreover, the NCTM expects teachers to create, support and sustain a culture of access and equity within mathematics (NCTM, 2012). In other words, mathematics teachers should be responsive to students' backgrounds, traditions, knowledge and cultural experiences to help foster educational growth.

It is also expected, according to NCTM principles, and standards, that mathematics teachers do the following: a) encourage students to reason mathematically; b) evaluate mathematical arguments both formally and informally; c) use the language of mathematics to communicate

ideas and information precisely; and d) make connections among mathematical topics to other disciplines (NCTM, 2012). In developing students' problem solving strategies and reasoning skills, NCTM expects secondary mathematics teachers to help students develop critical thinking skills. CRMP would enable secondary mathematics teachers to meet the goals and expectations of the NCTM by focusing on content integration, knowledge facilitation, prejudice reduction, social justice, and academic success for students.

Mathematics is comprised of a diversity of historical, cultural, social, and political human activities (Greer et al., 2009). It is grounded in human interactions with the environment and with one another, in the solving of practical problems and the human desire to transcend matters of simple survival (Gilsdorf, 2012). Contrary to the early influences in the field of mathematics which were predominantly mathematics itself and cognitive psychology, the political context of mathematics education within the United States is becoming increasingly apparent (Greer et al., 2009). It is within these political contexts that Black children in K-12, especially secondary mathematics, must emerge and not only see mathematics as a subject to learn but also as a liberating tool (Ford & King, 2014; Jackson & Howard, 2014; Leonard & Moore, 2014). In particular, diverse children in secondary mathematics are at the beginning stages of being able to politically affect their local and national community in terms of voting. Therefore, it is imperative that mathematics, through students own cultural experiences, be made available to them so that they may learn how to navigate through the U.S. system and affect positive changes within their local, state, national, and global communities.

Using CRP ideologies, high school mathematics teachers of diverse children can help facilitate reasoning, problem solving, and critical thinking skills within the mathematics classroom to help diverse children to become agents of change. CRMP makes the most of students' rich



cultural capital in order to make learning successful, and serve as a well-founded option for educating them (Jett, 2013). CRMP captures and nurtures the mathematical brilliance that diverse children bring to the classroom (Leonard & Martin, 2013) and provide teachers with opportunities to build positive relationships with students. The next section discusses literature regarding experiences of teachers who venture to adopt CRMP as an instructional framework.

### **Experiences of Teachers Adopting CRMP**

Ultimately, mathematics teachers play important roles in affording diverse children with opportunities for success. The inclusion of CRMP practices afford teachers with opportunities to academically, culturally, politically, and socially transform mathematics curriculum for students, and help teachers to address diverse student needs (Sampson & Garrison-Wade, 2010). Through reviewing literature dealing with affordances and constraints of mathematics teachers of who venture to adopt CRMP practices, I demonstrate the need for my study that addresses notable gaps in the literature.

What follows is not a description and analysis of all the literature that addresses culturally responsive mathematics pedagogy or a constructed summary of the sources I reviewed while doing this research. Instead, in the next two sections I will draw attention to several specific pieces of literature (see Appendix C) that provide insight into teachers' experiences using culturally responsive mathematics pedagogy as their instructional framework and the impact these frameworks has had on their relationship with students.

In the first section, I focus primarily on the affordances of mathematics teachers who venture to adopt CRMP as their teaching framework. This discussion about the affordances of teachers using culturally responsive pedagogical practices is design to draw attention to

how culturally responsive pedagogues navigate their classroom spaces and use CRMP practices to find success with their students. Afterward, I discuss some constraints of mathematics teachers adopting CRMP as part of their mathematics teaching practices. The discussion on constraints is designed to present overarching issues that many teachers face while seeking to become culturally responsive pedagogues.

**Affordances of mathematics teachers using CRMP.** Research provides evidence that some mathematics teachers of diverse children successfully infuse culturally responsive mathematics pedagogy in their classrooms. Many studies illustrate that culturally responsive teachers, despite barriers, implement CRMP practices that allow them to be successful in their mathematics classrooms (e.g., Aguirre, & del Rosario Zavala, 2013; Brown-Jeffy, 2009; Hernandez et al. 2013; Jackson, 2013; Leonard, 2008; Leonard & Moore, 2014). In this section, I describe how some teacher characteristics, norms, effects, and relations support the use of CRMP as part of teaching frameworks.

**Access to CRMP models.** Educators committed to the ideologies and practices of CRMP for mathematics classrooms often seek robust and comprehensive models of CRMP to teach their culturally and linguistically diverse students. Rubel and Chu (2012) conducted professional development projects with teachers at low-income, urban communities of color through a qualitative analysis of mathematics instruction from seven teachers. The purpose of Rubel and Chu's study was to examine how teachers used a model of CRMP such as Centering the Teaching of Mathematics on Urban Youth (CTMUY) program to implement culturally relevant mathematics pedagogy (CureMap) in their mathematics classrooms. Rubel and Chu used critical theory as a framework, and argued that CureMap style and model of teaching mathematics provided students with broader and deeper opportunities to learn mathematics. Data collected for the study

included observations of seven participating teachers, and visual analysis of student teacher interactions. The data analysis process was primarily interpretive, and in line with what Roulston (2010) considers to be reflective. Rubel and Chu found that when teachers are provided with a framework for teaching culturally relevant mathematics pedagogy (CureMap) students gained more opportunities to learn mathematics. The researchers identified two types of teaching tasks that the teachers used: a) low-level tasks; and b) higher-level tasks. They emphasized that the low-level tasks required students to memorized facts or execution of well-defined procedures and, accordingly, lend themselves to listening and practicing. In contrast, tasks with higher-level cognitive demands, afforded students with opportunities to deeply engage in the learning of mathematics in ways that allowed them to detect patterns or make and communicate connections across mathematical representations. The higher-level tasks, Rubel and Chu asserted, offered more varied opportunities for students.

Providing mathematics teachers with models of culturally responsive teaching practices helps to combat teachers' limited understanding of CRMP. In a qualitative study coupled with social constructionist theory Hernandez, Morales, and Shroyer (2013) created a framework that specifically identified culturally responsive strategies for teaching math and science, and got to their findings using a grounded theory approach. Hernandez et al., developed a model of culturally responsive teaching that involved three steps: a comprehensive review of the literature, a synthesis of the literature into thematic categories to capture the dispositions and behaviors of culturally responsive teaching, and the piloting of thematic categories with teacher candidates to validate the usefulness of the categories which helped to generate specific exemplars of behavior represented.

Participants in the study included 12 culturally and linguistically diverse preservice teachers who were part of a federally funded scholarship program known as Synergy as well as the federally funded Teacher Quality Enhancement grant, Equity & Access, which provided the infrastructure necessary for the delivery of a distance-based teacher education program. Data collected for the study involved interviews, observations, and document analysis. Hernandez et al., found that schools need to have model representations of CRP for mathematics and science classes, and that schools need teachers who not only understand the importance of effective science and math instruction, but also who understand the increasingly diverse students in their classrooms. Contained in their extensive literature review were works of several different scholars in the field of culturally relevant pedagogy including but not limited to Banks, Gay, Greene, Gutierrez, and Ladson-Billings. As a contribution to the larger field of study Hernandez et al. generated a model of culturally responsive teaching that can be a promising tool for comprehensively defining culturally responsive teaching in the context of teacher education.

Similar to both Rubel and Chu (2012) and Hernandez et al. (2013), Brandt and Chernoff (2015) weighed in on providing teachers with models of CRMP and the current state of culturally responsive mathematics teaching classrooms. They contend that the teaching and learning of mathematics should reflect and embrace the cultural diversity found in current mathematics classrooms. Therefore, providing models of CRMP and helping to define culturally responsive pedagogy in the context of mathematics teaching practices is an imperative step toward increasing teacher awareness and understanding of culturally responsive mathematics pedagogy. In essence, mathematics teaching should strive to build cultural competence, which makes it critical for prospective and practicing mathematics teachers to be exposed to perspectives and insights of the possibility of what urban schools, students, and teachers can accomplish rather than focus on

negative attributes, characteristics, situations, and experiences of urban schools. Brandt and Chernoff asserted that teachers must be provided with models of CRMP that offer conceptual and practical understandings of how to further integrate culturally responsive mathematics practices and culturally responsive teaching into mathematics classrooms to promote student interest and cultural validation.

***Connecting mathematics.*** A common practice of culturally responsive mathematics pedagogues involves connecting mathematics to students' lives. A Bonner and Adams (2012) qualitative study deconstructed the practices of a culturally responsive mathematics teacher in an effort to address the persistent gaps in mathematics achievement between students of color and White students at the elementary classroom level. Participants in the study included one elementary school teacher. Data collected for the study included semi structured interviews that were based on the interviewer's selection and interpretation. The researchers found four cornerstones of culturally responsive mathematics teaching that were embedded in practice and foundational to pedagogy. These four cornerstones are knowledge, communication, relationships/trust, and constant reflection and revision. To unearth the four cornerstones of their culturally responsive mathematics teacher participant, the researchers examined pedagogical and disciplinary methods. Bonner and Adams found that CRMP teachers supported vibrant classroom discussions that allowed students to maintain their cultural integrity, and required teachers to have understanding and awareness of equity pedagogies. Additionally, the four cornerstones help CRMP teachers connect mathematics to students' lives and guided the structure of the learning environment through dynamic interactions that contributed to student success.

***Knowledge of equity pedagogies.*** Teachers' knowledge of equity pedagogies affords them with opportunities to create culturally viable and sustaining learning experiences. Jackson (2013) framed a qualitative study using a social constructionism and critical race theory paradigm to explore elementary mathematics teachers' knowledge of equity pedagogy. Participants of Jackson's study included eight elementary mathematics teachers. Jackson analyzed participants' semi-structured interviews and found that teachers' knowledge of culturally relevant pedagogy, cultural competence, and critical consciousness contributed to their students' understanding and success with mathematics. Findings of Jackson's study indicated that the teacher participants understood that relationships between teachers and Black children must precede instruction. The elementary teachers in Jackson's study took time to establish positive relationships with their students to promote learning. Jackson also found that the teachers who invested in African American students, and had high expectations of them both inside and outside of the classroom influenced their students' quality of life. All the teachers expected their students to reach their highest potential and be successful.

According to Jackson, teachers who practiced CRP for mathematics in their classrooms capitalized on their students' strengths by assigning them leadership roles, as well as recognized their students' diversity both in population and in learning capabilities. Jackson maintained that the teachers in his study saw themselves and their students as a team working together. During mathematics lessons, the teachers allowed students to work either in pairs or in small groups. Students rarely work in isolation. If a student understood a mathematical concept and their peers did not, the student was expected to teach their peers the understood concept so that everyone could understand. All students were responsible for ensuring the success of other members in the classroom. The children in the classrooms were visible as teachers paid attention to how they

learned and differentiated the mathematics instruction accordingly. What was notable about Jackson's study was that it highlighted the importance of healthy teacher-student relational interactions, and how such interactions can mediate students' access to mathematics. The findings of Jackson's study are instrumental in the preparation for K-12 education mathematics teachers.

***Teacher-student relational interactions.*** In a qualitative case study, Battey (2013) examined the relational nature of teaching in an elementary mathematics classroom. Participants in Battey's study included a white female teacher, and 25 fourth grade students. The study was conducted at an urban K-5 elementary school of approximately 1,300 students who are mostly Latino (85 % , 15% African American) in the southwest USA. Data collected for the study involved the use of videos, field notes and interviews. Battey documented the types of knowledge, instruction, and relational interactions used with lower SES Latino and African American students in elementary school. Battey found four dimensions in which relational interactions mediated access to mathematics: addressing behavior, framing mathematics ability, acknowledging student contributions, and attending to culture and language. According to Battey all four relational interactions are important factors in shaping teacher-student relational interactions, speak to the quality of instruction that seeks to encourage student strategies, affirm students' mathematics ability, connect mathematics to familiar contexts, and help to move students to more sophisticated understanding of mathematics.

***Creating safe and inclusive classrooms.*** Prior to establishing and maintaining healthy teacher-student relationships culturally responsive mathematics teachers must create safe and inclusive classroom environments. In a qualitative study that focused primarily on middle level educators, Waddell (2014) utilized critical race theory lens to examine the teaching practices of six middle school mathematics teachers. Waddell incorporated the instrument

of culturally ambitious teaching practices in mathematics to consider the possibilities of developing academically challenging mathematics classrooms. Waddell's analysis of observations and video recordings of the participants' lessons found that the starting point for implementing CRP in mathematics classrooms began with the classroom environment. The essence of Waddell's finding is that students need to think carefully about how they fit into the classroom environment and how they can positively influence such an environment. According to Waddell, as fashioners of the classroom, teachers also need to think about how they situate themselves in the classroom community they are fashioning. Waddell suggested that by thinking about their own personal beliefs, culture, and mathematical learning habits and how these beliefs and habits influence their teaching practices and instruction teachers can begin to create safe spaces for students to learn mathematics.

Waddell also found that when mathematics teachers provide students with organized academic protocols students were able to build their mathematics learning. Math tasks were used to encourage students to take risks, listen and communicate effectively with each other mathematically. With supportive mediation from the teacher, students brought their experiential knowledge into the classroom. Teachers bridged students' representations of math with formal mathematics representations. As a result of shared diverse values and ideas stronger class communities were built. In addition, teachers' close attention to students enabled teachers to use students' cultural knowledge as a vehicle for learning. The CRP teachers in Waddell's study helped students maintain their cultural integrity as they aspired to achieve academic excellence. Waddell asserted that culturally relevant teaching encouraged both students and teachers to think about their own beliefs, culture, and learning habits, through analysis of how such beliefs and habits interact with teaching and learning practices. While, the



reviewed empirical studies will help to shape mathematics classroom practices for elementary and middle school teachers who seek to adopt CRP instruction as their framework, there is still a need for CRP mathematics to be incorporated at the secondary level.

Mathematics being comprised of a diversity of historical, cultural, social, and political human activities (Greer et al., 2009), and grounded in human interactions (Gilsdorf, 2012) the political context of mathematics education within the United States is becoming increasingly apparent (Greer et al., 2009). It is within these political contexts that children in secondary mathematics classrooms must emerge and not only see mathematics as a subject to learn but also as a liberating tool (Ford & King, 2014; Jackson & Howard, 2014; Leonard & Moore, 2014). Within the ideological framework of CRP is the idea that true education should stimulate a child's cultural, social, economic, and political consciousness. Secondary mathematics students approaching the ages allowable for voting are afforded with opportunities to politically affect their local and national communities. Therefore, it is imperative that mathematics teachers incorporate tenets of CRMP to evoke social and political consciousness within students so that they may learn how to navigate through the U.S. system and affect positive changes within their local, state, national, and global communities. Using CRP, secondary mathematics teachers can help to facilitate reasoning, problem solving, and critical thinking skills within the mathematics classroom to help historically marginalized students such as Black children to become agents of change.

***Utilizing student perspectives.*** Being agents of change, means secondary level mathematics students voice matters, and their perspectives on culturally responsive teaching have significant impact on culturally responsive mathematics classrooms. However very few studies examine students' perspectives of CRP. In a qualitative study, Hubert (2014) voiced students' perspectives on learning mathematics using CRP instructional practices. The purpose of Hubert's case

study was to capture student perspectives of culturally responsive mathematics instruction. Using semi-structured interviews, Hubert questioned what African-American high school students' perspectives were of culturally responsive mathematics, and whether or not culturally responsive instruction affected students' attitude and interests toward mathematics.

Hubert found that overall, the students had positive feelings toward culturally responsive mathematics instruction. Unsurprisingly, all of the students interviewed stated that they preferred being taught mathematics using CRP versus the traditional method of instruction and that culturally responsive mathematics instruction helped to increase their interest in mathematics. Students especially preferred CRP instructional practices because CRP “made the class feel more alive” (p. 329). While the framework of Hubert’s study was not explicitly stated, its findings lead to suggestions for teachers to create better classroom environments. Hubert’s efforts to bring about change in teachers planning suggest a framework of critical theory. Hubert’s objective of shining a light on the voices of the students contribute tremendously to the larger field. Hubert’s study empowers the voices of students, and call on mathematics teachers to become cultural pedagogues.

**Constraints of mathematics teachers using CRMP.** Despite the call for mathematics educators to become cultural pedagogues, there is literature that suggests teachers are constrained from becoming culturally responsive mathematics pedagogues due to policies and practices that pervades education. Such literature is important to this study. What follows are brief discussions of how various constraints impact both pre and in-service teachers’ journeys toward becoming culturally responsive mathematics pedagogues.

***Cultural mismatch.*** Current classroom demographic makeup can be characterized as “cultural interface zones” in which the culture of students and the culture of the teachers are in

conflict, and when the balance of power of such conflicts is not negotiated, student academic achievement suffers (Norman, Ault, Bentz, & Meskimen, 2001). This cultural and social homogeneity serve as a challenge for cultural hybridity and creates a barrier toward effective CRMP implementation. Furthermore, the current teaching force, which is culturally and socially homogenous produces cultural mismatch in classrooms between teachers and their students.

Cultural mismatch between teacher and student often lead far too many teachers to avoid culturally responsive mathematics teaching and instead employ textbook instruction and standardized test preparation models. Notable education scholars such as Irvine (2010) and Ladson-Billings (2006) have called for the promotion of cultural competence in classrooms as a matter of ‘ethical position’ (p. 40) where teachers must assume, or set predetermined strategies that work with every child of color. CRMP encourage teachers to learn more about their students’ different cultures. This is needed because in addition to limited understandings of what culturally responsive pedagogy is, far too many teachers have limited knowledge of the diverse students they serve, and view mathematics activities from their own personal perspectives as grounds for motivation in mathematics instruction (Howard, 2008). This limited knowledge of their diverse students is problematic because it limits mathematics teachers’ abilities to incorporate student’s cultural referents in mathematics classrooms. According to Irvine (2010), limited understanding of culturally responsive pedagogy has caused far too many teachers to assume that being culturally responsive means simply acknowledging ethnic holidays, including popular culture in the curriculum, or adopting everyday slang speech. Irvine warned that such an approach to culturally responsive teaching could result in ineffective instructional practices and counterproductive teacher-student relationships. In addition, such a mismatch of culture can limit teachers in their ability to connect in class mathematics with students out of school mathematical practices.

***Disconnect between in and out of school math practices.*** A Wager (2012) qualitative study framed under the lens of critical race theory and racial identity development found that connecting school mathematics to historical, cultural, social and political aspects of life is critical in enabling students to challenge inequities and their position in society. Examining reading reflections and interviews of 17 in-service teachers, Wager found that when teachers do not attend to how students use mathematics out-of-school students could develop narrow perspectives of school mathematics that is unrelated to how they think about real problems outside of school. Wager also found that when teachers drew on students' community and cultural knowledge, students became more interested and successful in their mathematics content. Teachers need to know how students use—and how they perceive that they use—mathematics in everyday situations.

***Viewing mathematics as culture free.*** A Leonard and Moore (2014) qualitative study through the lens of Freirean theory and critical race theory focused on engaging preservice teachers in activities that would enable them to write mathematics lesson plans and enact teaching practices that are consistent with social justice principles. The study was conducted with one cohort of study participants enrolled in a mathematics education course. The data collected for the study were field notes, teaching episodes, and teacher work samples in the form of pre and post essays. In analyzing their data Leonard and Moore found that many of the preservice teachers in their study believed that CRP for mathematics classrooms make mathematics more fun, exciting, engaging and empowering for students. Leonard and Moore also reported that some preservice teachers showed resistance to the use of culture in mathematics believing that “math is math”, and did not understand “what culture had to do with mathematics” (p.82). This notion that mathematics is culture free poses a plain imperative for teacher education programs and suggest a

sense of urgency in preparing teachers to meet the needs of diverse students who will have diverse understandings of the use and applicability of mathematics.

***Teacher attitudes toward students.*** Viewing mathematics as culture free or fear of addressing controversial issues are not the only factors restraining teachers from becoming cultural pedagogues in mathematics classrooms. Teachers with negative attitudes toward students constrain their use of students' cultural referents in mathematics classrooms. Negative teacher attitudes refer to actionable manner, disposition, and emotions teachers use to express their views upon students (Williams, Edwards, Kuhel, & Lim, 2016; Keller Boudreaux, 2016). Far too many teachers treat students as invisible, and miss student contributions because of issues of cultural and linguistic differences, low expectations, or deficit views of their diverse students (Ramirez, Gonzales-Galindo, & Roy, 2016). Adding to Ramirez et al., claim is the assertion that dominant views of CLD students are generally grounded in assimilation and deficit based practices (Greenfield, 2016), which can have negative impact on students' self-efficacy in mathematics.

In a qualitative study that used a grounded theory approach about teacher attitudes toward mathematics Geist (2015) found that teachers' negative attitudes toward mathematics have negative effects on the children they teach. The participants in Geist's study included 31 Head Start teachers from a rural Appalachian region of the United States. The sample was 100% White females, whose ages ranged from 25 to 57. Data collected for the study involved a questionnaire that was designed to gauge teachers' attitudes toward teaching mathematics, about the importance of mathematics and how they taught mathematics. Findings of Geist's study suggest that teacher feelings and attitude toward mathematics and their students influence mathematics anxiety in students, affect teacher curricular planning choices, as well as their own ability to teach mathematics as well.

***Biases.*** Biases differ from teacher attitudes and racism. Racism operates as part of a system used to regard one race superior to another and refers to the belief that race accounts for differences in human intelligence, character, and overall abilities (Ani, 2013; Anderson & Span, 2016). Biases refer to one's own preference and impartial judgement stemming from prejudice (Jackson, Appelgate, Seiler, Sheth, & Nadolny, 2016). Like racism, teacher biases are particularly harmful to their students. Within the context of school, teachers can be regarded as 'first responders' to in-class and in-school disruptive situations. Teachers holding bias perceptions of diverse children can add to disproportional punitive consequences of such children (Spencer, 2009), and can cause diverse children to experience "cultural discontinuity" or "cultural mismatch" in schools (Irvine, 1999; 2003). Culturally responsive mathematics pedagogy (CRMP) as a teaching framework challenge mathematics teachers to understand students' out of school experiences and can help to combat biases of teachers (Pittman, 2010). Some of the biases that constrain teachers' efforts to become culturally responsive pedagogues are both personal and structured.

*Personal biases.* With respect to personal biases, far too many teachers withhold instruction out of fear of being too political. In their explanatory designed mixed methods study, which used both quantitative and qualitative methods, researchers Simic-Muller, Fernandes, Felton-Koestler (2015) examined beliefs that their preservice teacher participants had about teaching real-world contexts in mathematics for which social justice issues, and children's home and cultural backgrounds were included. Data collected for the study included a survey with 92 preservice teachers and follow-up interviews with nine surveyed participants. Analysis of the data suggested that although preservice teachers were open to the idea of teaching mathematics through

real-world contexts, they were hesitant regarding the use of controversial issues, and often unable to provide concrete or non-trivial examples of what these different types of real-world contexts would look like in a mathematics classroom. The preservice teacher participants in the study also felt the need to avoid controversial topics based on the race and ethnicity of the students. Over 97% felt uncomfortable with incorporating social justice issue out of fear of losing their jobs due to parent and administration disapproval.

*Structural biases within learning materials.* In addition to the attitudes of mathematics teachers in the classroom, structural biases also play a major role in constraining teachers' efforts toward becoming cultural pedagogues. Structural biases (Buchanan, 2016) can include school culture, teacher practices, and learning materials such as textbooks that are not supportive of culturally and linguistically diverse students. Structural biases undermine teachers' abilities to facilitate learning (Bauml, 2015).

For example, concerning mathematics textbooks, far too many teachers rely heavily on the use of mathematics texts as a means of curriculum pacing and guides to teach and learn mathematics. The problem with the use of mathematics textbooks as the primary resource in the classroom is that the mathematics texts are often culturally biased. Though the textbooks may appear to be well organized, with good content criteria and supplementary resource materials for both teachers and students, there is typically little to no evidence of inclusion, equity, and diversity in mathematics textbooks. In fact heavy use of mathematics texts based on current mathematics curriculum can further exacerbate teachers constraints of becoming culturally responsive pedagogues given that current mathematics curriculum is not culturally diverse but instead deeply rooted in cultural experiences synonymous primarily with America's White middle-class (Oliver & Oliver, 2013).

In 2016, such a lack of diversity is an overall weakness in mathematics education. Pellegrino, Mann, and Russell (2013) suggested that teachers are over using textbooks to influence the scope and sequence of content instead of encouraging critical analysis and interpretative thinking skills. In other words, due to the excess use of mathematics textbooks in the classrooms, mathematical concepts and framework of textbooks become the primary lens through which students incorporate mathematical knowledge for the rest of their lives. With limited diversity within mathematics textbooks, students are then limited to a narrow scope of mathematics, uncomplementary of their diverse needs. Thus, the mathematics textbooks can serve as a major obstacle in many mathematics classrooms.

Bright's (2016) qualitative study used critical theory and feminist epistemologies, to question whether the mathematics presented in textbooks, trade books and standardized tests were neutral and to examine mathematics curricular materials through the lens of two questions: "What is valued?" and "Knowledge for whom?". The study's participants included 58 graduate students who were both preservice and in-service teachers. According to Bright, mathematics texts contained multiple examples of problems that reify hegemony, exploit people, and have a marked disregard for the environment. Essentially, Bright found that mathematics education as seen in the texts was decidedly not neutral, but was instead politically, socially and historically situated within a particular agenda.

Unsurprisingly, many educators who cling to the use of mathematics textbooks as primary resources for teaching and learning mathematics often do so for standardized testing accountability purposes. Supporters of the use of textbooks as primary resources in the mathematics classroom operate under the idea that the use of textbooks will better prepare students for



standardized tests. However, education scholars argue that current standardization and accountability education reform models and policies are part of subtractive learning models that inhibit teacher-student opportunities to engage in healthy discussions regarding diverse issues impacting diverse children (Chan, 2013; Sleeter & Stillman, 2013; Valenzuela, 2013).

***School reform models.*** In the past few years the federal government has wrested - control of schools from teachers and community leaders creating school reform models (SRMs) that have led to what is now standardized programmatic curriculum, otherwise known as high-stakes testing (Eakle, 2012; Thompson, 2007). The major stated goal of high-stakes testing is to improve schools. The governing belief of this component of school reform is that by tying negative consequences to standardized test performance, teachers and students in low performing schools will work harder and more effectively, thereby increasing what students learn. However, standardization has led to ineffective teaching. Current literature on SRMs show that such models ignore sociocultural issues that are relevant to diverse students (Brown-Jeffy & Cooper, 2011). To prepare for testing teachers neglect to recognize, value, or use students' cultural referents in mathematics classrooms. Such neglect contributes to traditionally marginalized students receiving sub-standard mathematics education (Berryman, Ford, Nevin, & Soo-Hoo, 2015).

Ukpokodu (2011) found that mathematics teachers were not engaged in culturally responsive mathematics teaching because they were concerned about satisfying curriculum standardization and preparing students for high-stakes testing. Participants in the study included preservice and in-service teachers enrolled in a graduate course at a large urban university in the United States. Data collected for the study involved structured in-class activities, online discussions, and the researcher's field notes. The structured activities involved prompts that were posted to the class following the researcher's review of students' personal goals and questions for the course.

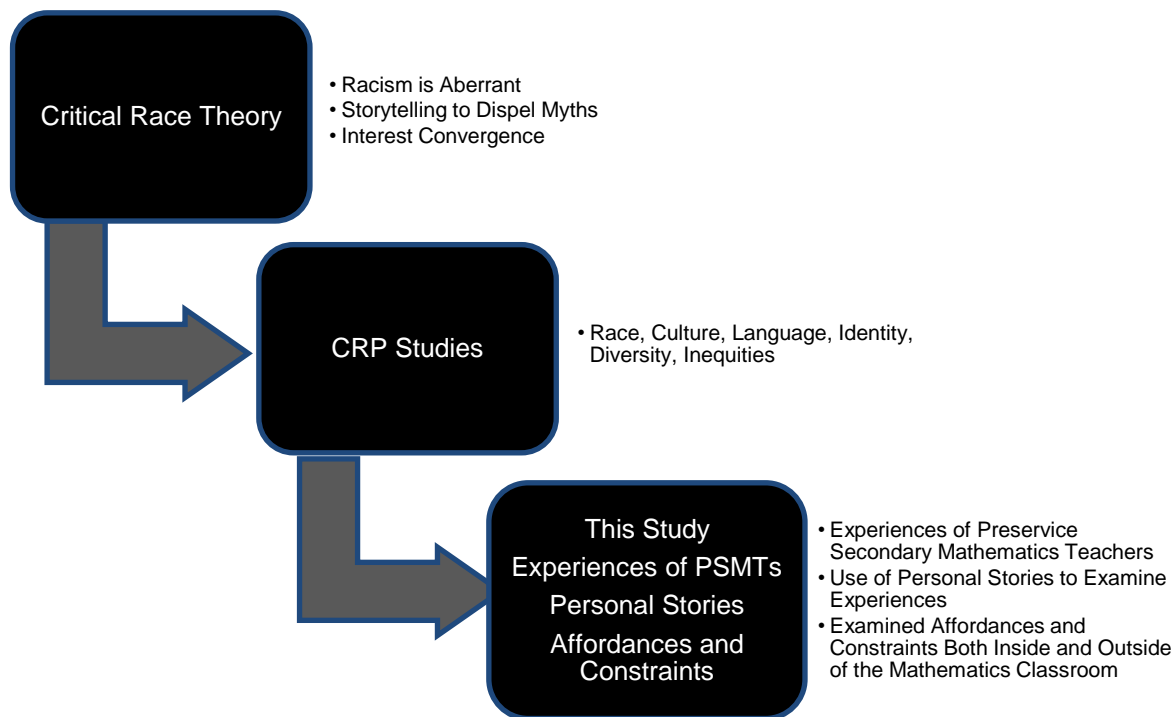
At the conclusion of the study, Ukpokodu found that teachers were not engaged in culturally responsive mathematics teaching because they were concerned about teaching to mandated standardized tests. Ukpokodu also found that teachers also had the convenience and dominance of textbook-based mathematics instruction and were primarily concerned with textbook knowledge and resources. Ukpokodu also asserted within the study's findings that for many teachers' difficulty in implementing CRP stemmed from lack of culturally responsive mathematics teaching models to emulate.

The reviewed empirical studies highlighted positive experiences of teachers who have worked beyond the confines of education to infuse CRMP models to facilitate their students' mathematics learning. The reviewed studies also show how some educational policies and practices, both local and national, have constrained teachers in their efforts to infuse culturally responsive mathematics pedagogy (CRP) in their mathematics classrooms. Following are highlights of specific gaps in the reviewed research and ways in which this study aims to address each specific gap.

### **Specific Gaps in Literature**

The continued inequitable practices found in schools suggest that more studies are needed to provide much needed discourse about what it means to be culturally responsive and how to help preservice teachers get there (Gutstein, 2012). In other words, teacher education programs must better prepare teachers to rise above constraints both inside and outside of classrooms to consistently and successfully implement culturally responsive mathematics pedagogy. Although the reviewed studies and other studies have established a pattern of factors that impact teachers' use of CRP in mathematics classrooms, limitations to these studies exist.

These limitations, or gaps, which are addressed in this study, include a focus on: 1) PSMTs; 2) PSMTs personal stories detailing their experiences using CRMP; and 3) analysis of PSMTs identified affordances and constraints from both inside and outside of the mathematics classroom that may have contributed to any challenges and transformations PSMTs encountered. Following are three paragraphs that describe the importance of a study, such as this study, that addresses each gap, but first Figure 1 demonstrates the relationships these gaps have within the broader structure of the aforementioned theoretical framework that guides this study.



*Figure 1.* Relationship of Specific Gaps to Theoretical Framework

*Experiences of preservice secondary mathematics teachers.* Several studies have explored PSMTs attitude toward culturally responsive teaching, but few studies address preservice teachers' experiences using culturally responsive mathematics teaching practices at the secondary level. For example, in the reviewed studies many of the researchers (e.g., Battey, 2013; Bonner, 2014; Jackson 2013; Ukpokodu, 2011; Waddell, 2013; Wager, 2012) focused on the experiences of in-service elementary, and middle level teachers respectively. Current studies, such as this study, are needed to explore the experiences of secondary level preservice mathematics teachers. An exploration of preservice secondary mathematics teachers' experiences using CRMP in their classrooms can lead to opportunities for self-examination. Research in the analysis of the mathematical experiences of preservice secondary mathematics teachers could produce recommendations to improve preservice mathematics teachers education and assist with supplying high quality teachers responsive to the needs of diverse children (Jett, 2013).

Additionally, dissecting the experiences of four preservice secondary mathematics teachers, can afford new and existing mathematics teachers with strategies on how to reach diverse children where they are and make children's mathematics learning experiences strong (Bonner & Adams, 2012). If mathematics teachings of diverse children is going to reflect the vision of researchers such as Ladson-Billings, Banks, Gay, Irvine, Nieto, Villegas, Darling-Hammond etc., and the standards as set forth by the National Council of Teachers of Mathematics (2012), then PSMTs will have to leave teacher preparation programs with experiences compatible with a culturally responsive vision of helping to create better educational experiences for diverse children. A study, like this study, on the examination of PSMTs experiences during their practicum can lead to the creation of improved educational experiences for mathematics teachers and their students.

*Using personal stories to examine experiences.* Even when preservice secondary mathematics teachers are participants of studies, as evident in the reviewed studies (e.g., Bright, 2016; Hernandez et al., 2013; Leonard & Moore, 2014), their personal stories are not collected as primary units of analysis. Personal stories about experiences are a memorable way to convey information and help shape understanding (McCulloch, Marshall, DeCuir-Gunby, & Caldwell, 2013). It is important to understand the extent to which new teachers find ways to uphold CRMP ideologies, practices and values. Furthermore, examining personal stories of individuals new to the field of education can explain events, stances taken and actions engaged in. When mathematics teachers' experiences are represented as **stories** it can become more organized and be used for analysis, critique and learning of CRMP mathematics (Bianchini, Dwyer, Brenner, & Wearly, 2015).

*Examining affordances and constraints both inside and outside the mathematics classrooms.* Overall, the previously reviewed studies, by focusing on the effectiveness of culturally responsive pedagogy in mathematics classrooms, helped to identify several affordances and constraints that affect mathematics teachers' use of culturally responsive practices. However, the examination within this study is not done by studying the effectiveness of culturally responsive pedagogy for the mathematics classroom, but instead, this study seeks to explore self-identified affordances and constraints of PSMTs that are provided both inside and outside of the mathematics classroom that might be reflected in PSMTs instructional practices and examine any implications for Black children.

This focus is helpful in framing the need for CRMP at the secondary level as a viable option to teach Black children mathematics. Mathematics classroom practices present themselves in forms of affordances or constraints for preservice teachers. Understanding these affordances and

constraints of PSMTs both inside and outside of the mathematics classroom is paramount in better preparing teachers to teach Black children. Examining affordances and constraints of beginning teachers can explain why and how things happen in mathematics classrooms, and shed light on why many preservice teachers are not utilizing culturally responsive practices in mathematics classrooms with fidelity (Gallimore & Goldenberg, 2001). The benefit of this knowledge regarding prospective teachers' affordances and constraints is that it provides opportunities to address classroom realities of teachers who venture to become culturally responsive and assist teacher educators with providing a course of action toward producing culturally responsive pedagogues.

### **Summary**

Based on the reviewed literature, there is a mixture of both challenges and successes for teachers who seek to implement culturally responsive mathematics pedagogy (CRMP). The continuously changing demographics and diverse settings, suggest that teacher education programs must lean toward the kind of awareness that supports the constructive management of sociocultural factors and perceptions influencing daily interactions occurring within the classroom (Wallace & Brand, 2012). Sociocultural factors and perceptions are arguably the most significant factors that constrain or afford teachers' use of CRMP. Sociocultural factors as part of mathematics instruction can be a daunting task for some teachers because they are uncomfortable with the responsibility of addressing culture in the classroom, and are primarily concerned about stereotyping and over generalizing, thus teachers intentionally disregard the existence of their students' culture in their classrooms (Tinkler & Tinkler, 2013). Furthermore, teachers are not comfortable with engaging students in culturally responsive mathematics teaching because they view

mathematics as culturally neutral (Ukpokodu, 2011). My study of preservice secondary mathematics teachers' experiences as they venture to use CRMP is critical in shaping and meeting the educational needs of students.

The next chapter focuses on the methodology of my study. Within the methodology chapter, I describe my research design and elaborate on how I carried out the study by identifying, describing, and providing a rationale for each step in my investigative process as I capture the experiences of four preservice secondary mathematics teachers who venture to use a culturally responsive approach to teaching mathematics.

## **CHAPTER 3 METHODOLOGY**

The purpose of my study was to examine preservice secondary mathematics teachers' (PSMTs) experiences using culturally responsive mathematics pedagogy (CRMP). The study also aimed to examine the affordances and constraints, if any, of these PSMTs as they venture to use CRMP ideologies and practices in their secondary mathematics classrooms. Critical race theory was the theoretical framework that grounded this study and determined how I collected and analyzed my data. This study was guided by the following research questions:

1. How do preservice secondary mathematics teachers (PSMTs) negotiate their experiences teaching mathematics to Black children while immersed in culturally responsive mathematics pedagogy (CRMP) professional learning activities during their practicum?
2. What affordances or constraints do PSMTs identify when teaching culturally responsive mathematics pedagogy?

### **Research Design**

This study employed a qualitative instrumental case study design. Qualitative research is driven by a desire to explain events through existing or emerging concepts (Yin, 2011). Such research places importance on interpretation (Stake, 2010) that gives emphasis to human values and experiences (Denzin & Lincoln, 2003). Instrumental qualitative case studies focus on issues or concerns (Merriam, 2016) that present particular situations intended to inform other situations or cases (Yin, 2011). Instrumental qualitative case study is a methodology that can be seen in diverse fields such as social and human sciences (Merriam, 2016). Instrumental qualitative case



study was relevant for this study's type of inquiry of preservice teachers' personal stories because it afforded ways in which to conduct in-depth examination of PSMTs personal stories thus offering deep insights into teachers' understanding and use of CRMP (Patton, 2015).

## **Context**

PSMTs were enrolled in a yearlong summer to summer initial teacher preparation and certification program that was part of a Masters of Arts of Teaching cohort program at an urban university in the Southeast region of the United States. Throughout the Masters of Arts of Teaching cohort program of study and within the methods courses and their clinical practices, the PSMTs were also engaged with an inclusion educator who encouraged and facilitated PSMTs' pedagogical practices in terms of building their lesson plans with a focus on culturally responsive pedagogy. I was a co-instructor of the course during the summer and then visited with PSMTs as a guest speaker during their Fall semester course. Throughout the summer and fall semesters of the program I was responsible for assigning CRMP readings, and facilitated online and in class discussions about race, culture, inequities, social justice, and the importance of critical thinking with and about mathematics. These discussions were necessary and encompassed the ideologies and practices of CRMP. At the time of the research study, all PSMTs were enrolled in their mathematics methods/practicum courses of their Masters of Arts of Teaching program and were placed in secondary schools (pseudonyms used for both PSMTs and their school placements) for their fall teaching experiences (see Table 2). The PSMTs are described in more depth under participants.

The chosen courses for this inquiry, an Introductory Methods course during the university's June 2016 semester, and an Advance Theory and Pedagogy Methods course during the

university's Fall 2016 semester, contained objectives and standards that were relevant to the purposes of this study. The courses were designed for students to actively examine the nature of secondary students and schools, explore instructional materials, teaching strategies, technology, and effective teaching. Students in both mathematics methods course engaged in historical and current research within the field of mathematics education. A critical analysis of the structures of schools and the teaching and learning of mathematics was coupled with a focus on earlier scholarship of John Dewey, W.E.B. DuBois, and Paulo Freire. Embedded in the course was an examination of equity issues in mathematics education and the situated, culturally relevant, and critical perspectives of sociocultural philosophy of education and an understanding of mathematics teaching and learning, which aimed to engage all children in the learning of meaningful mathematics with an emphasis on historically marginalized students (i.e. female students, students of color, low-socio-economic student, etc.).

### **Participant Selection**

**Criteria.** The population of the study was 13 preservice secondary mathematics teachers. Of the 13, four were purposefully chosen as participants in this study to examine their integration and use of culturally responsive mathematics pedagogy. Purposeful (purposive) sampling is done when the researcher deliberately selects participants based on the goal or purpose of the study to yield the most relevant and plentiful data given the research topic (Yin, 2011). Purposeful sampling was an appropriate sampling method to best answer the study's research questions, and purpose. According to Merriam (2016) and Stake (2010), the number of participants required to make up an adequate sample size for qualitative studies vary. For purposes of my study, the selection of four participants was both practical and feasible giving the study's time constraints. The three criteria used to select the four participants were: 1) holders of bachelor in mathematics

degree; 2) mathematics teaching/tutoring/coaching experience of 0-3 years; and 3) how detailed responses were to the administered demographic questionnaire. For the third criteria of the selection process I considered how well volunteers articulated themselves. In particular, given that the study sought to examine how the preservice teacher participants would negotiate their experiences teaching Black children using culturally responsive mathematics pedagogy, I carefully examined volunteer responses to the following questions: a) what do you think you need to learn about teaching mathematics to culturally diverse students; b) what could you learn from culturally diverse students; and c) what role should teachers play in encouraging pride in students' culture. In examining each volunteer response to the questions, I selected four participants whose responses addressed teacher expectations of students, behavior and discipline concerns about students, and a desire to want to learn how to teach 'other' students. I felt that responses involving expectations, discipline and teaching 'other' students would be important to discussions surrounding culturally responsive pedagogy. Although it was a mixed cohort of both males and females, only female cohort members satisfied the criteria. Additionally, the study's use of critical race theory as its framework allowed for the examination of race relations. Therefore, I purposefully selected two Black and two White females to account for possible race based perspectives.

**Procedure.** Approval through the Institutional Review Board, as well as consent from participants (see Appendix D) was granted to conduct the study, administer questionnaires, conduct individual interviews, and collect course work for the volunteered and purposeful selected PSMTs. To start the selection process, I first administered a demographics questionnaire (see Appendix E) to gather biographical and background data about each volunteer participant before purposefully selecting four PSMTs. Some of the background data included gender, age, degree earned, previous teaching mathematics experiences, and information on teaching and learning

philosophies. The sample selection reflected the makeup of the whole group, as close as possible, in terms of race and teaching experience. It is important for the sample selection of the study to reflect the race and teaching experiences of the whole group to get a representative sample of participants and prevent potential over or under representation. Representative samples help to ensure that all relevant types of participants are included in the study and can eliminate potential biases.

## Participants

The preservice teacher participants ranged from ages 23 to 48 and were placed in four different urban secondary schools. Pseudonyms are used for each preservice teacher participant and their schools of placement (see Table 2).

Table 2

### *Demographics of Participants*

Name	Age	Gender	Race	Previous Mathematics Teaching Experiences	School Placement During Study
Rose	48	Female	Black	Tutored in Advance Mathematics and Integrated Mathematics II	Abbensette High School 9 <sup>th</sup> Grade Students
Susan	25	Female	Black	Tutored in Secondary Level Mathematics.	Cortelyou High School 10 <sup>th</sup> Grade Students
Amanda	23	Female	White	Tutored in College Algebra, Mathematics Modeling, Advance Algebra, and Pre-Calculus.	Salem High School 10 <sup>th</sup> Grade Students
Marlene	23	Female	White	Tutored Mathematics and Tutored for ACT and SAT	Baird High School 11 <sup>th</sup> Grade Students

**Rose.** Rose is a 48-year-old Black woman who credits her mother with initiating her desire to become a mathematics teacher. As a child, Rose wanted to grow up and be a mathematics teacher just like her mother, and her great grandmother. She knew that she was part of a strong generation of women teachers that dated back to the early 1800s. Rose stated:

I came from generations of teachers that date back to the early 1880s. My great grandmother attended a teacher preparation program. My mother told me stories about my great grandmother and the passion for teaching others resonated well with me. (Interview Fall 2016)

Rose's mother was her model for success and intelligence. According to Rose, her mother was a "no-nonsense" Black woman considered brilliant by everyone who knew her. Throughout Rose's elementary and middle school experiences, her dream of becoming a mathematics teacher remained unchanged. However, this all changed for Rose during her high school career. Rose attended high school during the late 1970s and early years 1980s. For America, the 1960s was a time of civil unrest. Much like the present, Black Americans were fighting against injustice, brutality, and capriciousness that characterized their experiences in the U.S. Of Rose's experiences during this Era, in her writing assignment she stated: "My high school experiences were defined by two major events that changed my desire to become a mathematics teacher. The civil rights movement, and women's liberation movement changed the direction of my life, and my childhood dream was deferred".

Instead of becoming a mathematics teacher Rose decided to work in corporate America. After three years in corporate America, Rose became a corporate instructor of information technology. Even in her position as a corporate instructor of information Rose had an opportunity to experience her childhood dream of teaching, which she thoroughly enjoyed. In her writing assignment Rose said of her experience as a corporate instructor: "I can recall with great excitement the feeling I felt each time I contributed to helping fellow employees improve upon their

computer technology knowledge. I relished the challenge of turning “boring technical concepts” into relatable and reusable information”. Eventually, Rose’s department in the corporate sector closed due to corporate restructuring, and Rose returned to a previous job as a computer technical support. Twenty-one years later, Rose’s husband took her to A city park and asked her what she wanted to do with her life. Rose's answer, "teach math". A year later, Rose accepted a mathematics teaching position under a three-year provisional certificate contract.

Due to personal circumstances, Rose did not complete the provisional certificate program which resulted in her not being certified. However, because of her passion for teaching and learning Rose continued working in the classroom for two years as a middle and high school substitute teacher. It was during her working years as a substitute teacher that Rose heard about a Teaching Fellowship program in the Southeast region of the United States that granted persons interested in teaching opportunities to become certified teachers as part of a yearlong program. Rose immediately applied, and was accepted. Now Rose is a part of a teacher preparation program to become the mathematics teacher she has always dreamed of becoming. In her writing assignment Rose stated: “I am excited to be a part of a teacher preparation program. The coursework and experiences have been awesome. I feel a connection with the professors because of their passion for teaching and students”.

**Susan.** Susan is a 25-year-old Black woman. Growing up she engaged in activities that captured her mathematics curiosity. According to Susan, it was her curiosity that later led her to make decisions she felt were unpopular at the time. In her writing assignment, Susan stated the following of her childhood: “When I was younger I always found interest in the activities that many others did not, and later in life made decisions that not many would not”. Susan loved mathematics. She especially loved and enjoyed working on completing mathematics puzzles, and

anything that required mathematical thinking. Mathematics was consistently Susan's favorite subject, and she was always top of her mathematics class. Susan described her decision to pursue mathematics as taking the road less traveled but the one that has made all the difference. During her high school years, Susan often helped younger students who struggled with math. She was always filled with such joy and excitement when able to help someone understand a mathematical concept that they had once found difficult. For some, she was a motivating factor. Throughout her K-12 academic career, Susan believed a spirit of tenacity even in the face of adversity. In her writing assignment, she wrote: "For me, I was just doing what I enjoyed and found most interesting. However, what I didn't know at the time was that I was being set up for something greater".

As a high school junior, Susan excelled greatly in mathematics and was solicited by her mother's coworker for tutorial services to help her pass the mathematics portion of her general education diploma (GED) examination. The long telephone conversations discussing various strategies for approaching each mathematics question on the GED examination were the beginning stages of Susan's passion for teaching and helping others. In her writing assignment, she wrote: "I still remember how amazing it felt to hear that she had passed her exam. I was ecstatic and proud to know that I had impacted the life of someone else simply by helping with mathematics." When Susan began college, she was still unsure of what career she wanted to pursue. Nonetheless, Susan never had any doubt that she wanted to major in mathematics. Continuing her passion for tutoring and mentoring students in middle school, she worked in several capacities, including in-class intern, extended day and Saturday school intern, substitute teacher, and after school tutor. Upon graduating from University, Susan entered the world of corporate Amer-

ica as a financial analyst. Although she continued to volunteer as a mathematics tutor in the various cities that she worked, she felt it just was not enough to fill the growing void that she possessed. Ultimately, Susan found herself in a career that was unfulfilling, and lacked the desire to continue as a finance manager. After nearly three years of working in corporate finance, she knew that it was time to decide about the future of her career. Of her overall experiences that led her to her current journey of becoming a mathematics teacher Susan states:

As I looked back on my experiences in both finance and teaching, I found myself at a crossroad. I weighed pros and cons of each job, and it was clear that my heart was in education. To be in a profession that is both rewarding, challenging, and fulfilling of my passion is nothing short of amazing. (Personal Story Fall 2016)

**Amanda.** Amanda is a 23-year-old White woman. Since Amanda was three years old, she wanted to be a teacher. Growing up Amanda would make her sisters play school with her, where she would assume the role of the teacher. Eventually, when her siblings stopped wanting to play school with her, Amanda found other ways to be able to teach. As opportunities arose, Amanda would teach Sunday School or help her teacher write notes on the board. Amanda's passion for teaching progressed and it became more evident to her that she should pursue a career in teaching. In her writing assignment, she stated: "As time progressed, I realized that my calling in life was to teach and chose to continue to pursue it". During her middle school years, Amanda started to enjoy mathematics. Her liking for mathematics carried into her high school years where she excelled.

Amanda accentuated how she liked that there was always a "right" answer in mathematics. Amanda saw her middle and high school mathematics experience as good mathematics training years that helped to further cultivate her passion and excellence in mathematics. In recalling her middle school years Amanda wrote the following in her writing assignment: "My teachers in



middle school trained me to use certain procedures and steps to achieve the right answer. Mathematics was neat to me because it was something that could always work.”. Amanda’s high school experiences were like her middle school experiences in that she was successful in her mathematics classes. With regards to mathematics Amanda sums up her K-12 experience in her writing assignment as “Great. My memory was always great, so I excelled at mathematics”. Soon after high school, Amanda attended college where she majored in mathematics with a teaching concentration. It is during this time that Amanda’s venture into teaching would change her entire outlook on mathematics. The courses she took completely changed her view of mathematics. Regarding her college mathematics experiences, Amanda stated in her writing assignment: “In college, I decided to major in Mathematics with a teaching concentration. I began proofing things, which was a new concept to me. I did not understand why we must prove what we already assumed to be true”. As Amanda began to expand her understanding of the logics inherent in mathematics, she became more inclined to know "why" math worked. After experiencing proof writing, Amanda began taking more mathematics education courses, which helped her to develop conceptual understandings of concepts she had solely memorized procedurally. Once again changing her view of mathematics.

Regarding her changing understanding of mathematics and gaining conceptual understanding Amanda said the following in her writing assignment: “I was enthralled at how manipulatives can teach students. My love for teaching grew as I gained further understanding. I fell in love with sharing knowledge and experiences that the students could take with them forever”. Throughout Amanda’s college experiences she taught at three different Title I schools. Amanda sees her teaching career as an adventure and believes that her past, current, and future experiences are important to the kind of teacher she is today. In her writing assignment, Amanda

shared her favorite quote, which comes from Benjamin Franklin which states: "Tell me, and I forget. Teach me, and I remember. Involve me, and I learn". Amanda holds this quote close to her as she plans lessons. According to Amanda, her current experiences in graduate school has revealed the importance of student-centered learning and culturally relevant pedagogy and her experiences and who she is as a person has prepared her to continue what she calls an "adventure".

**Marlene.** Marlene is a 23-year-old White woman. Both Marlene, and her little sister were raised by their mother and a combination of their father, and first and second step-fathers, all of whom were deeply religious in the Southern Baptist vein. Marlene's life experiences have helped to mold her into the teacher that she is today. Coming from a homogenous community Marlene's lack of interactions with culturally and linguistically diverse people has been an obstacle in her journey toward becoming a mathematics teacher. In her writing assignment, she wrote: "My prior lack of culture and diversity has dealt me several obstacles that I am proud to have overcome (or continue to work on overcoming) in teaching such a diverse population".

Marlene grew up in a small town with a relatively homogeneous population. In describing her hometown, Marlene stated the following in her writing assignment: "Everyone looked like me, talked like me, and believed like me". Marlene was homeschooled until high school. It was her mother's way of protecting her from the ails of the town. As Marlene, puts it in her writing assignment "I was homeschooled so that my mom could "shield" me from the real world and those who would try to lead me astray". Marlene attended the only high school in the county where she excelled in academics, and most of the extra-curricular activities she tried. Marlene's experiences in high school were different. There were low graduation rates and college attendance rates that were lower than 10%. Nonetheless, Marlene remains thankful to high school math

teachers who made their job appealing, and rewarding. Because Marlene was good at mathematics and knew no other occupations involving math, she decided at an early age that she wanted to become a mathematics teacher.

In high school and college, Marlene tutored her peers and anyone else who needed it. She majored in mathematics and minored in education. Later in her graduate college experience, Marlene decided to “broaden her horizons” as she indicated in her writing assignment and applied to graduate school to as an Applied Mathematics Ph.D. student. After completing one year as a Ph.D. student, Marlene quickly realized that her true passion was education. Marlene decided she wanted to teach high school mathematics and accepted a provisional high school mathematics teaching position at a Math and Science Magnet school. Her current experiences as a teacher prompted her decision to pursue her initial teacher certification program. To sum up her teaching experiences thus far Marlene wrote the following in her writing assignment: “Attaining my teaching certificate while completing a Master’s degree, makes me feel very fortunate because I have found my passion so early in my life”.

### **Data Sources**

Data was triangulated using four data sources: 1) artifacts 2) interviews; 3) researcher’s introspection; and 4) demographic questionnaire. I focused my data collection to occur primarily during PSMTs summer and fall mathematics methods courses. Some of the artifacts collected for the study such as PSMTs reading reflections and personal stories were part of PSMTs writings for their mathematics methods course. Through the mathematics methods course participants were engaged in discussions both online and in class. Artifacts, such as lesson plans and PSMTs collage of major life experiences were submitted as part of evidence to support PSMTs use of

CRMP. Each instrument served a specific purpose to help answer the research questions posed in this study (see Table 3).

Table 3

*Data Collection Matrix*

Research Questions	Data Sources	Time Collected
RQ1: How do preservice secondary mathematics teachers (PSMTs) negotiate their experiences of teaching mathematics to Black children while immersed in culturally responsive mathematics pedagogy (CRMP) professional learning activities during their practicum?	Interview	Fall 2016
	Collection of Artifacts	Summer - Fall 2016
	Researcher Introspection	Summer - Fall 2016
	Demographic Questionnaire	Summer 2016
RQ2: What affordances or constraints do PSMTs identify when using culturally responsive mathematics pedagogy		

**Demographic questionnaire.** Demographic questionnaires in qualitative research is an efficient way to collect data as they allow respondents to elaborate on their answers (McLeod, 2014). This meant that as a researcher I could ask volunteer participants to elaborate on their responses. Administering the opened ended questionnaire (see Appendix E) to all 13 initial volunteer participants offered me more information within which to analyze responses to make purposeful selections of participants for my study. The demographic questionnaire was administered to the preservice teachers toward the end of the first day of their mathematics methods class, and only served as part of the participant selection process. Careful examination of PSMTs responses from the questionnaire helped me to identify those who articulated themselves well.

**Collection of artifacts.** The artifacts for the study included participants' personal stories in the form of a writing assignment, participants' reflections on their assigned culturally responsive reading, and the lesson plans they submitted to substantiate the degree to which they implement CRMP practices.

***Personal stories.*** As part of a writing assignment for the mathematics methods course, participants were required to write a personal story about their personal experiences using CRMP. A guide for writing personal stories (see Appendix F) was provided to participants. Participant's personal stories about their use of CRMP was collected as data. By writing personal stories, PSMTs were afforded an opportunity to open up and share their experiences using CRMP in their mathematics classrooms, as well as provided discursive vehicles for transforming their knowledge through the act of telling and translating stories (Cotton, 2010). Personal stories create their own bond and represent a shared understanding that helps to remind us of our identity related to other groups (Delgado, 1989). Collecting participants' personal stories as data was paramount to this study because it provided me with data that I could explore to show how pre-service secondary mathematics teachers (PSMTs) structured themselves, their Black students, mathematics, culture and society through stories. Another reflective process that PSMTs were afforded was CRMP reading reflections.

***CRMP reading reflections.*** Like their personal stories, PSMTs CRMP reading reflections were designed to inform and elicit detail descriptions of their understanding of scholarly literature on culturally responsive pedagogy. The CRMP readings were administered both throughout the summer and fall semesters of PSMTs mathematics methods courses (see Appendix G). In addition, PSMTs reading reflection aided in their participation in a window and mirror activity that involved sharing personal lived experiences as well as becoming aware of experiences of others.

The next paragraph details how an examination of PSMTs' lesson plans helped to provide a window into their acceptance of CRMP as a viable tool for teaching mathematics.

***Lesson plans.*** Teacher lesson plans are documents (Prior, 2003) that highlight important curriculum concepts and can serve as intentional talking points for teachers (Cotton, 2010). Thus, according to Prior (2003), PSMTs lesson plan documents are visible statements that exist as resources in schemes of action and can express or represent a set of discursive practices in support of social, political and cultural struggle. As part of the course expectation, PSMTs were taught how to design lesson plans that incorporate student cultures and were given a lesson plan template (see Appendix H). PSMTs were required to submit at least one of their lesson plans for their fall semester course as artifacts to show to what extent if any, PSMTs incorporated and supported culturally responsive mathematics in their lesson. An examination of PSMTs' lesson plans helped to provide a window into their acceptance of CRMP as a viable tool for teaching mathematics.

***Interviews.*** This study used two 30 minutes semi-structured individual interviews on two separate occasions at coffee shops outside of the general classroom and campus area. One interview session was for member checking and the other was for clarification purposes (see Table 4). For the interview involving clarification of participants' experiences, an interview protocol was used (see Appendix I) as a guide. During each interview sessions, participants were afforded opportunities to offer detailed information concerning their perceptions of CRMP as a viable tool to teach mathematics. Most of the interview questions were open ended questions to clarify participants' personal stories about their experiences using CRMP practices. Open ended interview questions in qualitative research is an efficient way to collect data as the open ended question

process allow respondents to elaborate on their answers beyond less detailed ‘yes’ or ‘no’ responses (McLeod, 2014). Asking PSMTs to elaborate on and clarify their responses was of great benefit to my study because it offered me more information and a better sense of what participants experienced. Clarification afforded participants with an opportunity to check my understanding and interpretation of their experiences and resolve misunderstandings and interpretations. Clarification was also an important tool used for this study’s credibility which is discussed in more detailed later in this chapter.

Table 4

*Interview Information*

Participant	Topic	Date	Length of time
Rose	Clarification of Personal Story	November 12, 2016	30minutes
	Member Check	January 2 <sup>nd</sup> , 2017	30minutes
Susan	Clarification of Personal Story	November 12, 2016	30minutes
	Member Check	December 28, 2016	30minutes
Amanda	Clarification of Personal Story	December 12, 2016	30minutes
	Member Check	January 5 <sup>th</sup> , 2017	30minutes
Marlene	Clarification of Personal Story	December 12, 2016	30minutes
	Member Check	January 3 <sup>rd</sup> , 2017	30minutes

**Researcher’s introspection.** The researcher serves as an instrument in a study (Stake, 2010), and a tool of analysis (Saldana 2009). In order to acknowledge the researcher as the tool of analysis, it is necessary for one to create and maintain a reflexivity journal to write memos

(Merriam, 2016; Saldana, 2009; Stake, 2010). Reflexivity journals are often referred to as analytic memos or memo writing, which can be useful for reflecting on emergent patterns, themes and concepts (Saldana, 2009). For this study, I created and maintained a reflexivity journal which helped me with documenting close reflections of potential findings and implications of my research study.

## **Data Analysis**

As I collected the study's data over the course of the summer and fall, I used CRT lens to simultaneously conduct preliminary and in depth analysis of each datum. Analyzing data simultaneously with collection is sensible and can be informative for researchers (Merriam, 2016). In describing my data analysis process, what follows next is a brief discussion of the methodological appropriateness of using CRT lens to analyze the study's data, a brief description of the study's method of analysis, phases of analysis, and tactics used to ensure credibility.

**Methodological lens used in this study.** Methodologically, employing critical race theory (CRT) as a framework contributes to qualitative research in that it allows the researcher to stand in a different relationship to both the research and researched (Ladson-Billings, 2000). CRT may assist preservice teachers in identifying and disrupting racial and cultural misinformation that are factors in the creation of current oppressive forms of education (Stinson & Walshaw, in press). Hence, CRT was methodologically appropriate for this study as storytelling was a significant component of this study. CRT employs storytelling as a voice to dispel myths, presuppositions, and discourse (Bryant et al., 2015). In this study, I used storytelling as a voice. I wanted the participants of my study to have a voice, and to be able to examine their voices for possible myths, presuppositions, and discourse that spoke to how they situated themselves and their students. I wanted to see how PSMTs in this study navigated race relations while using



CRMP in their mathematics classroom. PSMTs personal stories were analyzed for connections between their personal stories and their teaching practices. The voice of the PSMTs in my study was critical because of PSMTs different histories and experiences. PSMTs personal stories served as a vehicle to collect their thoughts and insights, which are necessary in understanding their experiences with using CRMP. Collecting and analyzing their personal stories helped to provide awareness about struggles and triumphs PSMTs experienced with CRMP.

**Thematic analysis and coding.** The primary unit of data analysis was PSMTs personal stories. As such, employing thematic analysis and thematic coding as an analytic tool (Saldana, 2009) was preferred in order to extensively examine PSMTs personal stories. In qualitative research personal stories can be the investigative focus (Merriam, 2016). Stories in this study occurred when participants engaged in sharing and recounting their experiences teaching diverse children using CRMP. Participants' reading reflections were analyzed using thematic analysis and thematic coding, to find themes and patterns that would crystallize the data for internal validity and credibility.

**Thematic analysis.** Thematic analysis is commonly used in qualitative research to identify and record themes or patterns within and across data sets (Saldana, 2009). I used thematic analysis for this study to identify themes from analysis of the study's data. Themes and patterns drive research findings, and are primarily based on the researcher's analysis of the data (Charmaz, 2003; Gibbs, 2007; Saldana, 2009). It is therefore imperative that measures are taken during data collection and analysis to reduce possibilities of a researcher's misinterpretation. Identified themes are also important to the description of a phenomenon that is associated and specific to the research questions (Charmaz, 2003; Gibbs, 2007; Saldana, 2009).

**Coding.** Coding in thematic analysis help to establish meaningful patterns, and can be done in phases. For this study, I used the following process to code the data: 1) compiled and familiarized myself with the study's data to generate initial codes; 2) searched for themes among codes; 3) reviewed themes, 4) defined, redefined, named and renamed themes in order to better reflect the study's data; and 5) wrote a final report to represent the study's findings (Charmaz, 2003; Gibbs, 2007; Saldana, 2009). I used five coding techniques to help analyze the study's data: 1) descriptive coding; 2) emotion and value coding; 3) versus coding; 4) open coding; and 5) themeing the data (Saldana, 2009). Overall the data for this study was codified in a systematic order (Saldana, 2009) to allow for grouping and regrouping in order to consolidate meaning and explanation (see Figure 2).

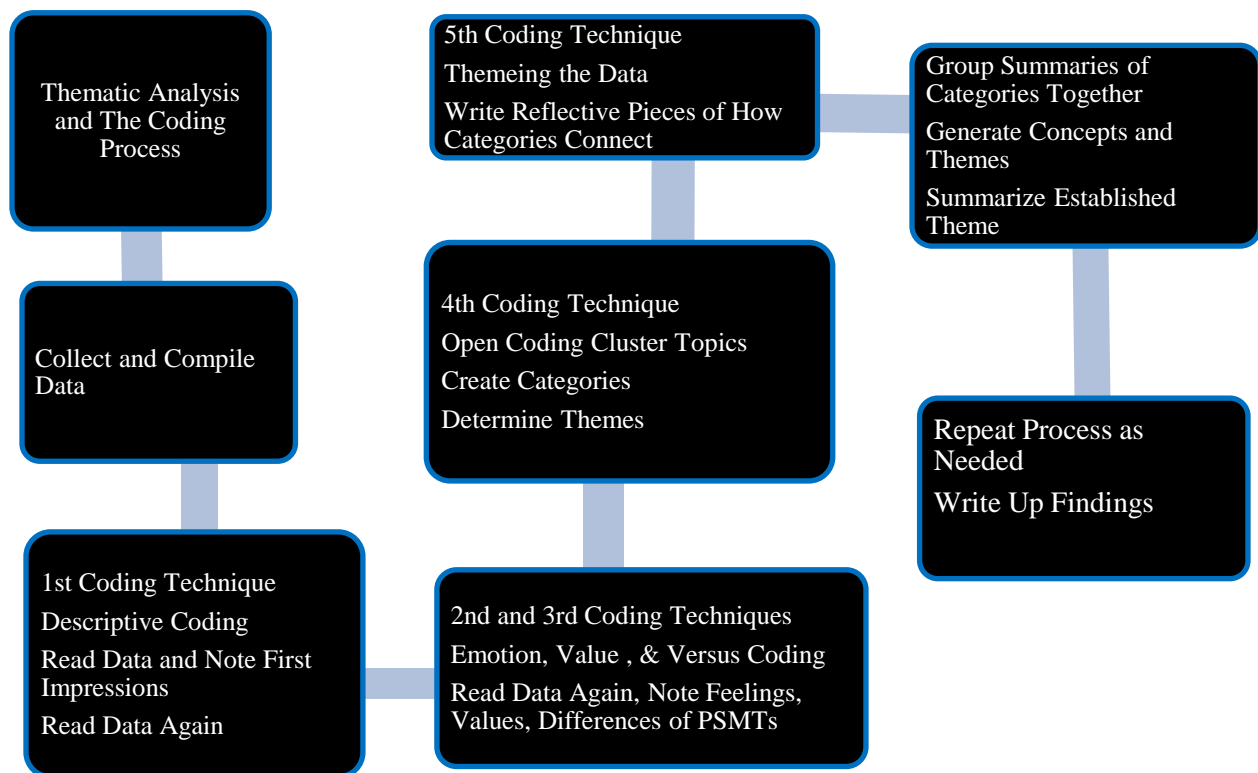


Figure 2. Systematic Order of Coding the Data

**Analysis process.** The analysis process was integrated and multilayered. The study produced a profuse amount of data. Therefore, as I sorted the data I was careful in discerning which aspects of the data would help me answer the study's research questions. Throughout the analysis phase of the study, I employed different coding and analytical techniques as part of my integrated analysis process. Altogether I used five coding techniques from Saldana (2009) and the six-step analysis process from Lichtman (2013).

***Coding techniques used from Saldana (2009).*** I used the five coding techniques as stated in Figure 2 to analyze the data:

- 1) Descriptive: Summarize passages and paragraphs using words and short phrases.
- 2) Emotion and Value: Look for and note emotions, values, likes, dislikes etc.
- 3) Versus: Look for and note conflict with self, policies, practices etc.
- 4) Open: Cluster topics and create categories
- 5) Theming the data: Grouping similar categories of data together.

Descriptive coding is a straightforward method for novices to qualitative research (Saldana, 2009). As an elemental method in first cycled coding, I used descriptive coding to summarize, in words and short phrases, the basic topic of each passage in PSMTs personal stories, reading reflections and interview transcripts. During descriptive coding start codes emerged (Saldana, 2009). The start codes were general summaries of large pieces of information. Generating the start codes was the first step needed as it set the foundation and development of a basic vocabulary of my data (Saldana, 2009). From the start codes, I could break down the information further.

The second coding technique I used was emotion coding to label the feelings of PSMTs. Emotion and value coding are part of the affective methods of coding used during first cycle coding. Affective methods investigate subjective qualities of human experiences (e.g., emotions, values, conflicts, judgments) by directly acknowledging and naming those experiences (Saldana, 2009). By zoning in on PSMTs emotions, I was better able to understand their stories and to write and capture their experiences in such a way that resonates with others. On the other hand, the use of value coding helped me to assess PSMTs integrated values, attitudes, perspectives, and belief systems. For example, it was important to examine the value PSMTs place on CRMP because it helped to determine how PSMTs used CRMP in their classrooms.

The third time I went through the data I used versus coding technique to identify power struggles that PSMTs might have in the classroom. Like emotion and value coding, versus coding is one of the affective methods of coding used during first cycle coding. Using versus coding techniques, researchers can acknowledge that humans are frequently in conflict. In this research study, which is grounded with critical race theory lens, versus coding is appropriate. Critical studies lend themselves to versus codes (Saldana, 2009).

The fourth coding technique involved open coding. After searching the data for PSMTs use of words or phrases that express emotions, values and opposition, I went through PSMTs personal stories again using open coding methods. During the open coding step of the data analysis I looked for recurring ideas and grouped them into two categories: 1) PSMTs critical reflections based on their perceptions, beliefs, values as it pertained to teaching Black children using CRMP; and 2) PSMTs use of CRMP. The categories were then organized into a chart for each teacher.

The fifth and final coding technique was themeing the data. Themeing the data is very like open coding in that it involved grouping similar categories of data together. Themeing the data is appropriate for virtually all qualitative studies, and is a strategic choice more applicable to participant-generated documents and artifacts (Saldana, 2009). Themeing the data in this study occurred after open coding and in the form of reflections of categories to produce concepts and themes. Themeing the data requires comparable reflection on participants' meanings (Saldana, 2009). After grouping the categories into concepts and later themes, I summarized with a reflective piece that wove the elements together for my write-up. My write-ups included a discussion of how the themes integrated and related to each other and I supported each write up with the themes and their data. The analysis process was not linear. The coding techniques were used to generate codes. After coding, I revisited the codes again using Lichtman (2013) six-step analysis process.

*Analytic steps used from Lichtman (2013).* Within the study's integrated and multi-layered analysis process, data gathered from the study's collection of artifacts, transcribed interviews, and researcher's introspection were examined for ways in which PSMTs negotiated their teaching experiences as well as what affordances and constraints they identified. After coding, I used Lichtman's six steps of analysis. Lichtman's suggested six steps of qualitative analysis are:

Step 1: Initial coding.

Step 2: Revisit initial coding

Step 3: Develop list of categories

Step 4: Modify initial list of codes as needed

Step 5: Revisit categories and subcategories. Concepts

Step 6: Generate themes

Using Lichtman's six steps of analysis, I started an initial coding (Step 1) of the data using descriptive, emotion, value, and versus coding techniques and extracted 50 start codes from the study's data. The following were the initial start codes of the data: (1) background differences are an issue, (2) own definition of CRP, (3) struggling with own teaching methods, (4) sees differences as an opportunity to teach differently, (5) goal for being culturally responsive, (6) student demographics, (7) similar background not an issue, (8) Black children's behavior unacceptable, (9) overwhelmed, (10) weary, (11) frustrated, (12) change in perspective after CRP learning activities, (13) view of Black children, (14) view of CRP teaching, (15) concerns with CRP, (16) establishing a need for CRP, (17) creating a rationale for CRP, (18) CRMP use in classrooms, (19) mentor teacher not supportive, (20) interpretation and application of CRMP, (21) extensive list of standards to cover is a problem, (22) amount of class time is a problem for CRMP, (23) curriculum guide and pace is a problem for CRMP, (24) building relationships with parents is a concern, (25) class size helps with CRMP, (26) technology helps with CRMP, (27) co-teaching helps with CRMP, (28) the teacher is an important part of CRMP, (29) identifying and connecting with CRP readings, (30) important aspects of teaching mathematics, (31) background experiences are deficits in cultural diversity, (32) interactions with Black children, (33) making math relevant to students is important, (34) limited access to student information is a problem for CRMP, (35) amount of class time helps CRMP, (36) applications of CRMP tenets to create lessons, (37) view of parents, (38) building relationships with Black children, (39) view of CRMP, (40) importance of CRMP, (41) mentor teacher is supportive, (42) not enough time to develop CRMP lesson plans, (43) developed a different understanding after CRMP learning activities, (44) school policies are a problem for CRMP, (45) social justice tenet is a struggle, (46)

teacher-student relational interactions, (47) cultural mismatch, (48) teacher attitudes toward students (49) integrating culture in mathematics is a struggle, and (50) fusing mathematics with culture is a problem.

Afterward, I revisited the initial codes (Step 2) to reword codes and create more meaning. I then developed categories (Step 3) that captured the essence of the data. In all two categories were developed to house each code. The two categories were: a) PSMTs perceptions, and b) PSMTs use of CRMP. For example, while hand coding the data I noticed that the PSMTs all shared their own view of CRMP as part of telling their stories. Therefore, codes such as view of CRMP and view of CRP teaching, etc. were categorized under PSMTs perceptions. According to Yin (2011), researchers need to consolidate their data to focus on the most significant aspects of their research. Thus, I modified the initial list of codes (Step 4) and generated eight salient codes. Next, I revisited the categories and subcategories (Step 5) and used the eight salient codes to generate five major concepts. I was careful to align the codes with one of the two categories, and to one of the five major concepts. Given the two categories, perceptions of negotiations and perceptions of affordances and constraints, the first six codes aligned with negotiations and the last two codes aligned with affordances and constraints. PSMTs negotiations stemmed from their interactions, interpretations, understandings, and immersion in CRMP activities. The last two codes, supportive and constrictive practices stemmed from practices both inside and outside of the classroom that supported or limited PSMTs use and integration of CRMP practices. With the research question and purpose in mind, I used the codes, categories, and concepts from the data to develop four themes that revealed PSMTs negotiations, affordances and constraints (see Table 5).

Table 5

*From Codes to Categories to Concepts and Themes*

Salient Codes	Categories	Concepts	Themes
Respect, interactions, connections, and good rapport are part of negotiating teaching experiences using CRMP.	Perceptions of Negotiations	Teacher characteristics, norms, effects, and relations affect CRMP practices	Inter- and Intra- personal race relationships are part of negotiating meaningful experiences with Black children.
Social upbringing and background experiences impact mathematics teaching and learning		Background experiences impact teacher-student relationships	PSMTs understanding of CRMP tenets impacted how they implement CRMP to teach Black children.
Teacher attitudes toward students affect teaching and learning mathematics		Beliefs about how Black children learn create spaces for negotiating meaningful experiences	Immersion in CRMP learning activities fostered awareness of racial and cultural issues in mathematics teaching and learning.
Developed awareness about racial and cultural issues in education impact use of CRMP practices to teach Mathematics to Black children			
CRMP activities lead to change in perspectives about how to teach mathematics			
Interpretation and application of CRMP	Perceptions of Affordances and Constraints		
Supportive practices		Supportive experiences inside/outside the classroom	School policies and practices provided supportive and constrictive opportunities for PSMTs to become culturally responsive mathematics teachers of Black children
Constrictive practices		Constrictive experiences inside/outside the classroom	



## **Credibility and Trustworthiness**

Patton (2015) argued that trustworthiness in research centers somewhat on the integrity of the researcher. Therefore, as the researcher, I employed techniques that show cased honesty, transparency, and required checking and rechecking of my data. Though qualitative researchers can never capture an objective “truth” or “reality” I used some strategies to increase the trustworthiness of my study (Merriam, 2016). Trustworthiness in a qualitative study can be achieved through the notion of credibility (Merriam, 2016). Credibility in a qualitative study refers to how credible the findings are given the data presented (Merriam, 2016). In order to maintain credibility in this study I adhered to three components suggested by Merriam (2016): triangulation, member checks, and adequate engagement in data collection. According to Merriam (2016) triangulation of multiple sources of data involve comparing and cross checking to increase credibility. As a form of triangulation, researchers can compare and cross check primary and secondary data collected from people with different perspectives or across data with the same people (Patton, 2015). For triangulation of the data, I used PSMTs reading reflections, interviews, lesson plans, and collage of their major life experiences to support the personal stories. The data were then checked in a subsequent member check.

Member checking was a deliberate strategy used for obtaining credibility. I used member checking in this study to reduce the possibility of false reporting of participants’ personal stories, and to clarify the data describing participants’ personal experiences. Participants were provided with a letter (see Appendix J) informing them of what a member check process was prior to conducting the member check. Member checks were conducted after my initial write up of the study’s findings. Through member checking, PSMTs provided appropriate feedback on their personal stories that are part of the analysis of the study’s findings. In addition to the letter, each

participant was given a member check comment sheet (see Appendix K), and their own personal story based on my write up and was asked to examine my interpretation of their personal journey, and provide feedback. Each participant was encouraged to use the member checking process to not only ensure the accuracy of their personal stories but also to give further explanations as needed. Participant's responses through the member check process, were used exclusively as a way to examine my interpretations, and retelling of their personal stories, and if needed, better capture my within case findings and analysis of their experiences with developing their own mathematics interest and identity, and ultimately their journey toward becoming mathematics teachers. Finally, to achieve necessary credibility as part of the qualitative process within my work, I maintained adequate engagement in the data collection process in order to gain clearer understanding of what participants were saying in their personal stories, and written CRMP reading reflections. Staying engaged in the data helped me to get rich understandings of the participant's view of CRMP and their experiences using CRMP in their mathematics classrooms.

**Establishing rapport with participants.** The participants viewed me both as a colleague, a fellow secondary mathematics teacher, and as a co-instructor for both of their mathematics methods courses. Specifically, PSMTs saw me as someone they could seek CRMP resources from, engage in CRMP discussions with, and as someone who was not out of touch with current teaching experiences. That is, PSMTs knew that I understood current classroom demographics and dynamics. Additionally, participants saw me as their connection to gaining a better understanding of CRMP and as someone who supported their journey toward the use of the ideologies and practices inherent in culturally responsive pedagogy for the mathematics classroom. All interactions, except for member checks, were done as a whole class, whether online or in the classroom (see Appendix L).

**Researcher's Positionality.** As the researcher, my lens was critical in this study. I was an instrument of the study. I conducted all of the culturally responsive mathematics professional learning activities: 1) CRMP reading and discussions; and 2) mirror and window activity with the participants. For example, the mirror and window activity required PSMTs to develop an awareness and understanding of their own identity as a prelude to understanding others. This type of self-reflection and awareness of one's interpersonal and intrapersonal insights are essential to teacher education programs and culturally responsive pedagogy because in order to understand others, individuals must first understand themselves (Maye & Day, 2012). Embracing the practice of how to develop culturally responsive teachers through professional noticing within teacher educator modelling (Averill, Anderson & Drake, 2015) and the sentiment of self-awareness, I used the idea of window and mirror from Badger (2015) and Kalinec-Craig (2014), created a collage of my pivotal experiences (see Appendix M), and shared those experiences with all of the preservice teachers. In addition to being an instrument of the study, I also collected and analyzed the study's data. Additionally, as the co-instructor of the course, during the summer and fall semesters I assigned CRMP readings, facilitated online and in class discussions, and assumed responsibilities for carrying out the necessities of the study such as collecting personal stories and scheduling interviews for clarifications and member checks.

**Researcher's Subjectivities.** My subjectivities proliferate from my upbringing in Guyana, South America, my experiences as a student in New York City public schools, my experiences as a Black undergraduate student studying mathematics at the University of Nebraska-Lincoln with a starkly different cultural background than both the teachers and students, my current experiences as a Black educator, and my current experiences as a mother of four Black children. According to Richardson and Adams St. Pierre (2005) in qualitative studies the product cannot

be separated from its producer, mode of production, or method of knowing. How authors position themselves as knowers and tellers is intertwined in their problems of subjectivity. In qualitative studies, it is important that researchers acknowledge their positionality and are aware that their personal experiences are contributing lens through which they analyze their study's data (Richardson & Adams St. Pierre, 2005).

My positionality stems, in part, from my current role as a secondary mathematics teacher who subscribes to the ideologies and practices of culturally responsive pedagogy. Although, after graduating with my mathematics degree from the University of Nebraska-Lincoln, I had not planned to become a teacher/educator I was drawn inexorably to the profession, and saw teaching as way to give back to my community. After six years of teaching, I returned to school to obtain my doctorate degree in education. Since becoming a doctoral student, I became aware of culturally responsive teaching ideologies and practices, and how it can serve as a viable option to improve the K – 12 learning experiences of marginalized students such as Black children. Apart from knowledge of the subject matter, I help to educate my students with love, respect, great determination, and personal integrity. As their mathematics teacher, I have successfully incorporated the ideologies and practices of CRMP to help transform my students' mathematics classroom experience to one where they learn how to think not just about numbers, but how to collaborate effectively to solve problems, how to acquire knowledge, and in particular how to examine the consequences of their actions. I continue to mentor and advise students even after they have completed my classes. I am confident that acknowledging and being aware of my own potential biases was used to help further my research. The personal connections gained through my various experiences helped to direct my research in finding possible solutions to my research topic and make assertions as to the findings. Given my subjectivities and the instrumental role I played

in the study I took necessary steps towards establishing trustworthiness in my study. In other words, although my subjectivity was there, I used member checks and triangulation to ensure that it did not interfere with my findings. I was extremely cautious not to make any of my biases affect any parts of the reported findings.

### **Delimitations**

Overall, qualitative studies are limited in their inability to generalize findings (Stake, 2010) and this study is no exception. There were four limitations to this study. First, the qualitative methodology employed by the study's focus on four preservice secondary mathematics teachers during their practicum experience limits the generalizability of its findings. Second, the study did not employ observations as a data source. Observations of PSMTs in their classrooms, could have afforded the researcher with visuals of how PSMTs negotiated their experiences, and witness some occurrences, of affordances and constraints, inside the classroom. Third, during the CRMP activities the study did not utilize videos of both pre- and in-service teachers who embed CRMP practices in their classrooms. Providing PSMTs with visuals of culturally responsive mathematics pedagogues offers additional references for PSMTs. Fourth, data were collected during one part of their teacher preparation rather than throughout their preparation program. This time frame can serve as a limitation because observation is limited only to the start of a process and not the evolution of the entire process. So, for example, the researcher is not able to observe a PSMTs fidelity to the tenets of CRMP after becoming a full-fledged teacher say three or five years hence. However, this study is controlled by the researcher's general proposition to examine how PSMTs might negotiate their experiences to better educate underserved students such as Black children using culturally responsive pedagogical practices for mathematics classrooms,

which are based on previous scholarship and the study's finding. Future research based on observations in actual classrooms could validate whether these PSMTs understanding and use of CRMP during their practicum experiences lead to their consistent and authentic incorporation of CRMP when teaching mathematics.

## **Summary**

In this methodological chapter, I have discussed how I used an instrumental qualitative case study methodology to explore how four preservice secondary mathematics teachers (PSMTs) negotiated their experiences using culturally responsive pedagogy to teach mathematics. To answer the study's questions, I administered a questionnaire to help in the selection process of the participants, collected participants' guided reflections on CRMP readings, collected participants' artifacts such as lesson plans and their collage of personal experiences, and utilized participants' personal stories as primary unit of analysis to reach my study's findings. As part of the credibility process, I invited participants to perform member checks so that my interpretation of the data and their personal stories of their experiences using CRMP were through their contexts. This was very important to the credibility of my research findings, which is discussed, in the next chapter.

## CHAPTER 4 RESULTS

The purpose of this study was to examine how four preservice secondary mathematics teachers (PSMTs) negotiated their experiences using culturally responsive mathematics pedagogy (CRMP) in diverse classrooms. The study's inquiry was guided by the following research questions

1. How do preservice secondary mathematics teachers (PSMTs) negotiate their experiences teaching mathematics to Black children while immersed in culturally responsive mathematics pedagogy (CRMP) professional learning activities during their practicum?
2. What affordances or constraints do PSMTs identify when teaching culturally responsive mathematics pedagogy?

Utilizing a critical race theory (CRT) framework to analyze the collected data I sought to examine PSMTs experiences including any affordances or constraints that PSMTs identified while using the ideologies of CRMP to teach. Grounded in CRT, my analysis of the data focused primarily on PSMTs storytelling to capture and share their experiences. However, all the data in the study were parsed to help answer the study's research questions. The findings of this study are governed by PSMTs perception of how they negotiated their experiences as well as their perception of affordances and constraints that impacted their use of culturally responsive mathematics pedagogy to teach Black children.

### **Findings**

Four themes emerged related to how PSMTs negotiate their experiences using CRMP to teach Black children mathematics: 1) Inter- and Intra- personal race relationships both inside and outside of the mathematics classroom were part of PSMTs negotiated teaching experiences with

Black children; 2) Immersion in CRMP learning activities fostered PSMTs awareness of racial and cultural issues in mathematics teaching and learning; 3) PSMTs understanding of CRMP tenets impacted how they implemented CRMP to teach Black children; and 4) School policies and practices provided supportive and constrictive opportunities for PSMTs to become culturally responsive mathematics teachers of Black children. The four emerged themes are reported in two categories 1) PSMTs perceptions of negotiations; and 2) PSMTs perceptions of affordances and constraints. The first category will report themes one, two, and three, which result from PSMTs shared experiences on how race relationships, immersion in CRMP activities, and leaning on their own interpretation and understanding of CRMP tenets impacted their use and implementation of CRMP to teach Black children. The second category will report theme four which stemmed from PSMTs experiences navigating school policies and practices while implementing culturally responsive mathematics pedagogical practices.

### **PSMTs Perceptions of Negotiations: Themes 1, 2, and 3**

**Theme 1: Inter- and Intra- personal race relationships both inside and outside of the mathematics classroom were part of PSMTs negotiated teaching experiences with Black children.** The PSMTs all expressed how their interpersonal and intrapersonal relationships both inside and outside of the mathematics classroom were part of finding their own path to teaching Black children mathematics using CRMP. The inter- and intra- personal race relationships that impacted PSMTs teaching experiences with Black children stemmed from their perceptions of respect, their interactions and connections with students, PSMTs social upbringing, background experiences, as well as their desire to build good rapport with Black children.



Building rapport and connecting to students as part of negotiated teaching experiences is evident with participant Rose who has had an informative preservice teaching experience at Abensette High School. Overall, Rose has been amazed by the general attitude of her ninth-grade students. Both Rose and her mentor teacher have over 180 students, including a daily advisory class. Two of Rose's students are Latino, one student is White, and all other students are Black. Rose credits her positive interaction with her Black students to her understanding of what it means to be culturally responsive and the importance of building positive teacher- student relationships. For Rose, culturally responsive teaching starts with establishing respectful relationships with students. In her writing assignment, she stated: "The students are respectful to me and are willing to follow my direction with little resistance because I respect their space and there need to interact with each other." Rose expressed that as an African-American tenth grade mathematics teacher in a predominantly Black, urban school she is attuned to the important role she plays in the lives of her students and strives to provide them with unique learning experiences that helps them to become productive citizens. Rose believed that positive learning experiences are first accompanied through connecting with students. With this philosophy, Rose described how the students often challenged her attempts to connect with them. In her writing assignment Rose explained:

In the beginning of my teaching when I tried to connect on a cultural level with my students. To my surprise, they would not allow me to connect with them. They unconsciously tried to differentiate themselves from me. They asked me, "What are you mixed with? You have shiny hair." I told them that I am African-American mixed with African-American. "You are different from the other Black teachers. Where are you from?" I told them that I am a Southern native educated in public schools. "You are too nice for these kids. You should teach at a private school." I learned from these students that they wanted acceptance and encouragement and someone who would believe in them and their ability to learn, but they wanted me to be different so that they could aspire to be different. Finally, one student asked me if I thought that their class could be successful as students. I replied positively and with encouragement. (Personal Story Fall 2016)

Rose admitted that at first, she did not know how to respond, but she knew she would not give up on her students. Rose expressed that she was saddened to know that her students did not feel that they could be successful as African-Americans from this southern part of the U.S. Rose emphasized that her students felt that success would be more achievable if they were from another state or culture, had mixed heritage, or some other differentiating factor. Rose also recognized that as their mathematics teacher she is provided daily with many opportunities to learn about her students. She admits that although it was challenging in the beginning she has now learned much about her students, which has enabled her to reach out to them and find alternative and less "traditional" ways to help them. Rose provided the following situation in her writing assignment as an example of how she adjusted and interacted with a particular student since becoming more aware of culturally responsive teaching practices and the importance of patience:

I have a male student, whom I will refer to as Jason, who showed more interest in his cell phone and holding conversations with another student than math. In fact, he was rude to me one day for asking him to get on task. His friend, whom I will refer to as Andre, asked Jason if he heard me speaking to him. I interrupted and stated that I knew Jason was 'dissing' me and I calmly walked away. The next time I approached Jason, he was successfully working some problems, and I complimented him on his work. He smiled and continued working and began participating in the classroom discussion. Soon, Jason was writing his solutions on the smartboard. During the next class session, he asked me if he could work ahead. (Personal Story Fall 2016)

Rose believed that if she had stereotyped Jason as another African-American male student with issues that she did not have time to understand, Jason would have missed his learning opportunities, and his classmates would have had a negative opinion of his academic ability. Rose emphasized that Jason's participation demonstrated to other students that doing well in math is "cool" for everyone. Rose is in no way discouraged by any dim experiences she sometimes encounter in her mathematics classroom. She remains encouraged that her presence is necessary to help African-American students gain success. As a matter of fact Rose insisted that more African-

American teachers should take on leadership roles as mathematics teachers serving African-American students. In her writing assignment, Rose elaborated more on her view:

I believed then, and I believe now that I can have the most positive impact on African-American youth as an African-American female math teacher. My presence is proof to young African-American females that math is not reserved for males. For African-American males, my presence in the classroom is evidence that math is not reserved for white males, and that their sisters and daughters can be mathematicians. (Personal Story Fall 2016)

Rose emphasized that she is in a special position, as a high school mathematics teacher, to encourage more African-American students to pursue mathematics. Rose embraced this unique position as a form of tradition passed down from her mother. Rose felt a responsibility toward spreading her excitement about mathematics to other African-American students in hopes that they too would strive to understand, learn and use mathematics.

In another instance, Susan understood the importance of establishing a good rapport with her students. When Susan interacted with her students, she tried to be genuine and true to herself. Susan was very open with her students and shared her experiences with them. In her writing assignment Susan explained: "Just as I want to get to know my students for who they are, they deserve to gain a holistic view of who I am. When various topics arise as a result of problem discussions, I always try to share my experiences with my students and engage in the conversation as well". Susan believed that when students feel comfortable with a teacher and find commonalities in their teachers' backgrounds or experiences, it opens the door for more dialogue and understanding of different cultures. Dialogue is important to bridging gaps and so Susan found ways and opportunities to engage in constant dialogue with her students. Susan articulated in her writing assignment: "As the year has progressed, I have found that the transition time between classes is also an excellent time to interact with students". For Susan, any opportunity to engage with students was an opportunity she embraced. Susan shared an example of how she sometimes

interacted with her students at the classroom door. She wrote: "Students stop by my door to talk about everything from their struggles with a particular concept to the latest trends in fashion." Susan emphasized that the relationship she developed with her students have proved to be the biggest contributor to her success in the classroom.

Susan emphasized that for many students, math is one of their least favorite subjects. Some of Susan's students, in particular, want to give up at first sight of a challenging problem rather than embracing the learning that they can gain from it. However, as part of establishing a relationship with her students, Susan believed that it is her responsibility to help students shift their perception about mathematics learning. She emphasized the importance of learning about her students and being more attuned with her students' cultural practices and customs. Susan elaborated more on the importance of understanding the different cultures of her students when she wrote:

As I continue to develop my personal teaching philosophy, student culture remains a critical focus in my methodologies and practices. Classrooms with diverse cultures will require me to make a very personal commitment to the teaching and learning process of my students. (CRMP Reading Reflection Summer 2016)

A major classroom priority for Susan is establishing a good relationship with her students and getting to know who they are. She believes that neglecting to focus on the very essence of what makes her students who they are can have a ripple effect. Susan wrote in her fall writing assignment of her personal story: "As a culturally responsive teacher, it is my duty to ensure that I respect my students' culture within the classroom in regard to ethnicity, language, and the content that I am teaching". Without that foundation of respect, Susan believed her instruction would have a limited impact.

Early in her preservice teaching experience Amanda developed an understanding of how her students race and culture mattered. In her summer reading reflection of Ladson-Billings (1995a) Amanda wrote:

I am aware of the fact that I will be teaching in an urban setting with mostly African American students. As the reading emphasizes it is important that as teachers we make our students feel comfortable, supported, culturally accepted, and capable of success which are all values I wish to establish in my classroom environment. (CRMP Reading Reflection Summer 2016)

Amanda's overall lived experiences have occurred within predominantly White contexts and by Fall 2016 Amanda was very conscious of her Whiteness in a Black classroom. In her writing assignment she cited instances of friends and family who thought poorly and negatively about her Black students and who believed that her Black students were not capable of learning. Amanda's friends, family, and some of her colleagues questioned her students' ability to learn mathematics because her students were Black. In her writing assignment Amanda shared some of the comments her friends and family made in describing her Black students:

When friends, family, and other teachers found out what school I would be at this year, I heard many of their assumptions, without ever asking for them. I heard, "Those kids cannot," "Those kids won't," "Oh, they all get free lunch?", and "Oh, they are probably 'thugs'." (Personal Story Fall 2016)

Amanda expressed disgust for the impressions her friends and family have had of her Black students. Amanda wrote: "Just because students receive free lunch does not mean we should lower our expectations. My expectations for them are high". Amanda's experience with her White friends and family highlighted a real distorted view that some White people hold concerning the education of Black children. On the other hand, Amanda's view of her Black students and her understanding of them appeared to be complex. In establishing a relationship with her Black students Amanda began to see herself as the emblem of 'good love' and her students as knowing on

examples of 'bad love'. Amanda wrote the following regarding how she viewed her students and the important role she believed to have played in their lives:

From various comments my students make, I am now aware of the broken families they come from and/or bad examples of "love" they have seen. My students know that I am engaged, and I share with them the stories of my plans with my fiancé. I have seen their surprised looks and they make statements such as, "I hope I am as happy as you one day." This has created a positive environment in which they can ask me questions and see how love can work. One student even asked me to be their mentor. (Personal Story Fall 2016)

Amanda believed that because she has opened up in honest interactions with her students, it has created a safe place for them. Amanda emphasized that her students inform her with matters they need help with. In her writing assignment she stated that her interactions with her Black students is "positivity that goes a long way". Amanda wrote that she loved her Black students and that her students continually show her how wonderful they are.

Marlene was raised in a homogeneous community, and her experiences helped to influence her view of her students and her approach to teaching them. During her teaching Marlene struggled with interacting with her students and formulated many skewed assumptions about her students and their learning. Marlene expressed the following in her writing assignment:

Some of my assumptions included thinking that my students most likely had non-traditional homes, and parents who were too busy to care. I also assumed that many of them would not go to college because it didn't seem like that was a priority for my students. My outlook has changed after interacting with more students and parents. While I am still a little bit wary of raising my standards of discipline and achievement too high, I think that the more exposure and experience I have with the culture of my students, the better I will be able to relate to and teach them, and that is my goal. (Personal Story Fall 2016)

The demographics of Marlene's students are very different between the two courses that she taught. Reflecting on the demographic makeup of her class, Marlene wrote: "In my on-level courses of juniors, 68% of my students are Black, 23% are Hispanic or Latino, and 9% are White (like me). In my Finance course, only 44% of my students are Black, 2% Hispanic, 49% White, and 5% Asian." Marlene's breakdown and emphasis on her students' demographics is important

to her critical race based experiences and interactions with her students and is reflective of her schooling experiences that were located in predominantly White contexts. Marlene cited instances of noticing key differences in her students based on their race. She wrote:

I find that I have much more in common with the students in my finance classes, who act more like I acted when I was in school despite the fact that the majority of my White students are also Jewish (which I am not). My first days on the job were shocking. The behavior of my Black students was not what I was expecting, and was unacceptable in my eyes. Some students would walk around while I was trying to teach, or speak out loud over me. They didn't get quiet when I asked them to, and they had apparently never developed the ability to whisper. It was a very frustrating year for me, because even when I realized that my students did not need to behave like I would have in the same situation, I struggled to set boundaries for them without stepping on toes (or getting called a racist). (Personal Story Fall 2016)

Marlene struggled to establish a relationship with her students and likened her teaching experiences of predominantly Black students with the Teel (2008). Marlene learned of Teel's experiences during her Fall mathematics methods course. The Teel (2008) class reading seemed to have resonated well with Marlene. In her reading reflection Marlene described her feelings with attempting to develop a relationship with her students:

I think that Teel (2008) put my feelings into words when she said that she "felt more comfortable reprimanding [her] White students and pushing them to achieve, reinforcing the attitude and approach [she] thought their parents used. With [her] African American students, [she]... was confused about the ways they treated [her] and one another, and was reluctant to seriously reprimand them for fear of... becoming even more alienated from them" (p. 142). (CRMP Reading Reflection Fall 2016)

Marlene's identification and connection with Teel (2008) was in contrast to how she felt regarding Bonner and Adams (2012). The Bonner and Adams class reading about being culturally responsive to students seemed an unrealistic feat to Marlene. Marlene wrote the following in her summer CRMP reading reflection:

I have a few issues with the article describing Ms. Finley, the first of which is the fact that she grew up like her students and I didn't. Seeing how she related to her students doesn't help me because if I go into a classroom and say "You my sista now!" I don't think it would be received very well, even after a good rapport is established. Secondly,

she must have been spending 80 hours per week at the school! She wrote and directed the play, taught parents at night, and sewed graduation gowns for all of her female students. I think these are very unrealistic expectations from young teachers who are potentially still in school and are starting families. (CRMP Reading Reflection Summer 2016)

Marlene's perspectives on teaching and establishing relationships with her students often conflicts with what she has learned about how to teach cultures other than her own. Marlene explained in her fall semester writing assignment of her personal story: "Since the readings my perspective has changed about how to teach other cultures (especially African American students), even though I did not agree with everything that I read during the summer classes the readings and the discussions were helpful."

Marlene believed that her relationship with her students is steadily improving and her awareness of her students race and culture, after studying culturally relevant pedagogy, has helped her interactions and teaching to be more smooth. Nonetheless, she emphasized that building relationships with her students and incorporating their cultural referents continues to be a struggle. During her interview Marlene shared more of her feelings about relating to her Black students: "It's hard for me, I think I've learned a lot but I still don't know a lot about the students' culture itself again I was not raised anywhere near it so I don't know yet what I can do."

Marlene expressed a desire to be a good teacher and believed effective teaching requires hard work because you have to build positive relationships with students first in order to help them learn. Marlene found it frustrating that so many articles she read on CRMP recommended that teachers get to know their students and parents and be actively involved in the school and community. Marlene referenced one article in particular from the summer readings that seemed unrealistic and impractical for teachers, especially beginning teachers. Marlene wrote:

One article, in particular, gave a very unrealistic example of a teacher who was "doing it all" (Bonner & Adams, 2012). I thought this plan might work for elementary schools where the teacher only has twenty-five students, but how could it work for me, with 150



students and completely unresponsive parents. How can I build deep relationships with thirty kids at a time when I only have 50 minutes a day to cover dozens of standards? How can I be personally responsible for the achievement of all of my students when some don't care even a little bit. These questions plagued me. (CRMP Reading Reflection Summer 2016)

Even with the best intentions, establishing a rapport with her Black students continues to be difficult for Marlene. In her personal story, Marlene wrote: "I still feel that I am almost too different from my students to build a relationship with them. My skin, culture, religion, interests, and many other things are different." Marlene believed that her students' differentness was an obstacle toward developing teacher-student relationships and trust. She viewed her race and cultural differences as an ongoing struggle against establishing meaningful relationships with her Black students.

**Theme 2: Immersion in CRMP learning activities fostered PSMTs awareness of racial and cultural issues in mathematics teaching and learning.** There is a sense of urgency in fostering preservice mathematics teachers' awareness of racial and cultural issues in mathematics education (Buchanan, 2015; Frye, Button, Kelly, & Button, 2010). Interactions with CRMP learning activities that involved reading about how culturally responsive mathematics teaching practices serve as viable options for teaching Black children, about gaps in academic achievements, and engaging in discussions about racial and cultural differences all helped to shaped PSMTs awareness about racial and cultural issues in mathematics teaching and learning. PSMTs all shared critical reflections about race and culture that captured their attitude towards issues of race and culture in the mathematics. PSMTs reflected on their experiences using CRMP and shared their opinions on how Black students should learn mathematics.

Grappling with the issue of inequitable practices surrounding race and culture in U.S. classrooms, Rose expressed her contempt for the un-impactful and minimal ways in which African American culture is incorporated in U.S. schools. Rose viewed her racial and cultural identity as an African American woman as an affordance to teaching the Black children in her classroom and felt she possessed the character traits needed to be a successful mathematics instructor for Black students. She believed that, because she could identify with the students she could have the most positive impact. In her interview, Rose stated:

I have a passion for them and their struggle, I believe in them, I don't think that math is something foreign to Black children I see it in their music, I see it in all the things that they do it's just a matter of gaining their confidence in math and just showing them where math and their lives connect so you know it helps them with their math anxiety and language. (Interview Fall 2016)

Rose was concerned about the minimization of African American contributions to mathematics and worried that the deliberate removal of African American contributions to the field of mathematics is negatively impacting African American students and their academic performance in mathematics. In her writing assignment, Rose explained:

If you take a group of people out of anything educational then they don't connect to anything so when you look at all of the great scientists you don't see a lot, or you are not exposed to a lot of math from African Americans so African American students generally don't connect to those things but when you see music culture you see African Americans everywhere, when you see sports culture you see African Americans everywhere so they connect to that. (Personal Story 2016)

Even though Rose was always one of the top performers in her U.S. K-12 schooling experiences, she argued that the underlying U.S. curriculum devalues African American culture. In her reading reflection Rose wrote:

The readings are confirmation of my feelings regarding the education of African-American students. It has always appeared to me that the underlying curriculum always devalued basic tenets of African-American culture. Adding a few ethnic names to word problems in mathematics is just a superficial gesture. I am ecstatic to know that educators have researched the "miseducation" of America and sufficient data is available to support

substantive changes in American education. All American children require a relevant and responsive curriculum. The dominant culture is not taught to appreciate African-American culture as an integral part of American culture. By treating African-American culture as an “extra”, an “ethnic issue”, or only relevant in specific genres, i.e. sports, we disconnect our African-American culture from American culture fostering racism and socio-economic disparity. As a teacher, I want to bridge this cultural education gap.

Rose appreciated the reading assignments and discussions that were part of learning about CRMP. After reading about culturally responsive pedagogy, Rose delighted in knowing that educators both inside and outside of the African American culture have completed substantial research into the need for culturally responsive teaching, and understand how important and necessary culturally relevant learning is for responsible citizenship in a democratic society. Rose emphasized that as part of a democratic society Black people should be recognized, respected, and appreciated for their accomplishments as part of the U.S. Rose wrote in her reading reflection:

African Americans can only become fully enfranchised when they are valued and respected as members of an American culture. This can only be achieved through an education system that recognizes and values all students and their varying backgrounds. African American students do not require “special education”, they require relevant education. As a teacher, I want to bridge this cultural education gap. (CRMP Reading Reflection Summer 2016)

Rose emphasized what she believed to be an underlying truth that is sometimes lost in discussions about issues of race in U.S. education. Rose wrote in her writing assignment: “the current traditional educational system is tailored to a specific culture that is White, middle class, two-parent household, and suburban” Rose emphasized that in order to succeed, education must be delivered by teachers who are familiar with the cultures of their students. She believed that teachers must, in addition to being mathematics content proficient, seek to understand their students, as well as accept and value the culture of their student body. To this Rose wrote:

These students do not always have dreams and need the encouragement and caring of a teacher fully invested in the success of student learning. These teachers must be visible in the community outside of the classroom; such visibility builds bonding and trust with

students and provides the teacher with a foundation for cultural relevance in the classroom through personal observation and experience. (Personal Story Fall 2016)

Like Rose, Susan challenged what she considers to be a Eurocentric mathematics curriculum. Susan believed that it is important that educators broaden their view of mathematics, and shift away from a solely Eurocentric view of mathematics. After reading Gay (2002), Susan admitted that she had to think about her lack of knowledge of the many contributions people of color have made to the field of mathematics. With regards to the reading Susan stated: “Gay’s assessment of culturally responsive teaching caused me to evaluate my lack of knowledge of contributions of different ethnic groups to STEM fields and inspired me to take a more active interest in expanding my knowledge base of math history”. Susan emphasized that teachers’ perspectives of mathematics is limited, and given these limitations teachers can be of a disservice to their students by ignoring mathematical ideas of diverse peoples. In her reading reflection Susan explained:

Teachers have to be willing and committed to not only making math relevant to students but also teaching in a manner that is culturally responsive. I believe that we should empower students through their rich history by teaching them about the significance of the mathematical contributions of their ancestors. My commitment to math instruction has propelled me to personally learn more about the history of the subject so that I can better instruct my students. (CRMP Reading Reflection Summer 2016)

A significant outcome of immersing PSMTs in CRMP learning activities is that it can helped to developed awareness of racial and cultural issues in mathematics education. While Rose and Susan challenged Eurocentric mathematics curriculum, Marlene addressed noted race based gaps in mathematics achievement at Baird High School. Marlene saw her role and potential as a mathematics teacher as one that could help her students improve their academic performances. Marlene recently examined her school's list of the bottom 30% of students in mathematics and science. In her fall semester writing assignment Marlene stated that the list showed a

“steady stream of African-American and Hispanic/Latino students”. Marlene added: “Because I don’t believe that one race is inherently dumber than others, I must conclude that the way math is taught and assessed is what is causing Black students to fail at much higher rates than White students”. Marlene emphasized that she believed that school systems should promote equity, not equality, and ensure that students have the same opportunities even if it means they have different experiences. Marlene further elaborated and wrote:

Surely with such an institutional discrepancy, we must adjust to reach all of our students instead of just the White ones. I think that no matter how we accomplish it, we must close the vast divide between the achievement of our culturally diverse students. I will push myself to work harder and care deeper until all of my students are reaching their full potential. (Personal Story Fall 2016)

Susan believed that her immersion into CRMP practices heightened her awareness as to racial and cultural issues in mathematics education. After her engagement with CRMP readings (see Appendix G) Susan believed that in order to challenge deficit views teachers hold of Black students and challenge dominant narratives of failures surrounding Black children teachers should strive to emulate ways to enhance curriculum and reach beyond the realms of societal expectations. This practice she believed would be an asset to mathematics education. In her reading reflection Susan wrote:

Considering the misconceptions of the failures of African American students and the subsequent views of their teachers there is a need to place more attention on the successes of African American students, their teachers use of CRMP, as well as how success is measured. (CRMP Reading Reflection Summer 2016)

Susan believed that part of relating to her Black students and promoting their academic success involve an understanding of their home and community. Cortelyou High School where Susan teaches is considered to be an economically disadvantaged school with an 80% poverty rate. According to Susan her Black students and their parents don’t have the resources to solicit supplemental learning materials for test preparation and learning mathematics. Therefore, to better meet

her students in that regard, Susan provided tutorial and extra support for her students. In her writing assignment Susan elaborated on how she navigated her school day to ensure her students had opportunities to prepare for national exams: "Each day, I spend 10-15 minutes of time discussing SAT math problems and strategies. Students are unable to pay hundreds of dollars for a SAT preparation class, so we as teachers must adjust lessons to ensure that students have the opportunity to learn those critical skills. Susan's attitude and actions in response to the economic disadvantages of her Black students was an example of how teacher attitude toward Black students impact mathematics teaching and learning.

**Theme 3: PSMTs understanding of CRMP tenets impacted how they implemented CRMP to teach Black children.** After being immersed in culturally responsive professional learning activities PSMTs began to interpret and ascribe to the ideologies of culturally responsive teaching in their own ways. Unsurprisingly, the PSMTs all had varying interpretations and definitions of what CRMP meant to them as well as unique ways of implementing CRMP practices in their mathematics classroom to teach Black children. For example, Amanda described CRMP as taking a subject that tends to feel so distant to students and integrating the content into their culture while for Marlene, culturally relevant pedagogy meant that when she taught mathematics she made decisions based on her students' characteristics. On the other hand, Susan believed that culture plays a pivotal role in both teaching and learning mathematics and sees CRMP as a kind of pedagogical practice that she can add to her teaching toolbox. In her reading reflection, Susan wrote: "Culturally responsive teaching leads to students becoming catalysts of change in their communities, which speaks volumes to the type of impact that I can have on my students by continuously making a connection between the classroom and the community." As for Rose, she believed that teacher's pedagogical practices influence what and how their students

learn. Therefore, Rose's approach to using CRMP to teach mathematics is to question the need for mathematics in her students' lives. In her writing assignment Rose wrote that of how she asked herself questions before engaging in culturally responsive practices. Rose explained: "I typically ask myself important questions such "What is culturally responsive mathematics for the Algebra I students at Abbensette High School? What do these students need to know to function as active citizens who contribute to the improvement of their community?" Using Hernandez et al. (2013) model of CRMP tenets to conceptually frame the ideologies of CRMP and a lesson template (see Appendix I) PSMTs embarked upon their journey of implementing CRMP practices to teach Black children. The five CRMP tenets relevant to this study were: 1) content integration; 2) knowledge facilitation construction; 3) prejudice reduction; 4) social justice; and 5) academic development. The tenets were presented to PSMTs as being equally important and as part of a viable option for teaching Black children mathematics. Each participant shared their interpretation and application of each tenet. Next I share each PSMTs interpretation and application of each of the five CRMP tenets, content integration, knowledge facilitating knowledge construction, prejudice reduction, social justice, and academic development, specific to this study.

***Content integration.*** Rose expressed that many of her students have difficulty translating word problems into mathematical equations and inequalities, and seldom see the point in learning how to develop mathematical statements. Rose consciously interjects everyday activities into every math concept and embraces cooperative learning to engage all students. In her writing assignment Rose elaborated on how she integrated students lived experiences into her mathematics content:

Dance is very popular within the African-American culture. When explaining slope to a group of my African-American female students, I used a line dancing example rather than the usual rise over run example. The girls enjoyed watching me execute a dance move

and related it to movement along the line. I connected what seemed like an abstract term to their culture. (Personal Story Fall 2016)

Rose believed that making mathematics relevant to her Black students was an important part of their learning. She worked diligently to ensure that she provided a bridge between her instructional lessons and her students' experiences. For example, during a discussion Rose had with her students about adding and subtracting mixed numbers where the minuend was a whole number and the subtrahend was a fraction with an 8 in the denominator, Rose decided to use pizza to illustrate. In her writing assignment Rose elaborated on her illustration:

I gave students a scenario where there were two pizzas. I asked the students how much pizza would remain if a student, Kevin, wanted one slice of pizza. Student Jared immediately said, one box and  $\frac{7}{8}$  of the other box. I noticed that students often confuse “percent of” with “percent off.” I asked students if they prefer to pay 30% off the regular price or 30% of the regular price. To my surprise, the students began questioning each other and offering their own scenarios for discussion. I released the discussion to the students and reduced my role as facilitator. I am determined “never to say something that a student could say. (Personal Story Fall 2016)

For Susan, she saw content integration as the foundation of CRMP. She believed that content integration referred to the fusion of student backgrounds and culture and course content. In her writing assignment Susan shared how she fused her students' backgrounds and culture with the mathematics content:

I used a game called “Trashketball” to review problems for their upcoming PSAT. The lesson was two-fold in its response to student cultures and backgrounds. The students were engaged in the activity through its similarity to basketball, and because I incorporated their favorite athletes and teams they enjoyed the lesson. (Personal Story Fall 2016)

Susan believed that when teachers can incorporate a plethora of cultural materials, artifacts, and values into teaching mathematics, students can begin to make connections. In her interview Susan shared another example of how she integrated her students' cultural experiences in one of her mathematics lesson:



In one lesson, I used the tune of a familiar childhood song to help students remember the quadratic formula. They used their desks and pencils to make the sounds of drums and create a beat. I think that they appreciated my willingness to place myself at center stage and sing to them, despite my lack of singing abilities. Students took any and every opportunity to sing their song, which was fun and it helped them to remember an important equation. (Personal Story Fall 2016)

Susan viewed mathematics teaching and learning as complex. She emphasized that in today's diverse classrooms culturally responsive mathematics instruction is a crucial factor in student learning, and the relationship between math and culture is often extensive. The practice of integrating mathematics content with students' cultural referents was particularly challenging for Susan when she attempted to introduce her student to Pascal's triangle. In her writing assignment Susan wrote:

When introducing students to Pascal's triangle, I thought it would be great to provide students with the history of Pascal. Though I spoke briefly about the famous mathematician, the looks of boredom and lack of interest made the moment feel like hours. When I proceeded to the next portion of the lesson, I made an impromptu decision to make it a competitive activity. For me, that experience served as a reminder of the importance of knowing the students and how they best respond to different teaching strategies. The engagement and involvement grew as students raced to discover patterns in Pascal's triangle. Reflecting on that experience, I realize that integrating culture into that discussion would have made for a more exciting opening to the lesson. (Personal Story Fall 2016)

For Amanda, the process of integrating students culture into mathematics curriculum proved to be a struggle. In her reading reflection Amanda stated: "When I begin thinking of integrating culture, my mind tends to separate mathematics and culture making it a challenge." Amanda teaches three classes each day. Two of her classes are Analytic Geometry A and Analytic Geometry B with Analytic Geometry B being comprised of students who have failed a mathematics course before or are repeating the course. All of Amanda's students are African Americans. One of her student has an accommodation plan that is designed to meet their special education needs. Amanda has taken the time to get to know her students well. She tried to create

lesson plans, that have her students' best interest in mind, to keep them engaged. From the student interest survey that her students created, Amanda saw that her students loved music and sports so she decided to use both as a way of integrating students culture. In her writing assignment, she shared two examples of how she used her students love for music and sports to keep them engaged:

#### Example 1

One way my mentor teacher and I have ensured that we are aware of who they are is by having them fill out a “Student Interest” Survey at the beginning of the year. This has allowed me to create ideas based on their interest. In particular, I saw that many of them loved basketball or played basketball. The day before PSAT testing, we wanted the students to review some problems and have time to destress. I planned for a day of “Trashketball”. (Personal Story Fall 2016)

#### Example 2

I played appropriate music while they worked. We listen to mathematics formula songs and the catchy music remains in their brain. I tend to view this process as integrating the students' life experiences and academic content. I changed the word problems and it forced the students to calculate their total spending on name brand shoes. They had to compare it to if they bought cheaper shoes. Then determine the difference in the two totals, and pretend they were applying to a college fund. The kids saw how they could actually choose to save for college which is a big issue here. From discussions, I have gathered that a majority of the parents have not attended college. So, culturally the students are used to stopping their education after high school or in the middle. Even so, creating relevant mathematics content for instruction can sometimes be a challenge. (Personal Story Fall 2016)

For Marlene content integration occurs when teachers integrate items, concepts, or ideas from their students' lives into the substance of the course. She has seen several examples of integrating math into local social and political issues such as zoning for schools and voting, and proximity of liquor stores to schools. Marlene's difficulty with those examples is that she believed that the projects would be quite long, and probably only cover one or two of the course standards. Marlene also found it difficult to get good work out of her students when benchmarks

assessments were viewed as more important. However, Marlene found ways to incorporate student interest into the word problems that she wrote for her students and incorporated real life connections. In her writing assignment Marlene wrote:

For instance, I know that my students value shoes based on their conversations in the classroom and the fact that my students admire shoes in class on a weekly basis. So, when I write problems about money, I try to include items that my students might want to purchase. I also incorporate my students' extra-curricular activities like sports and jobs. My students respond well to these problems and remain engaged. (Personal Story Fall 2016)

***Facilitating knowledge construction.*** Rose believes that when learners have difficulty with syntax and terms, allowing them to match problem and solution is an effective strategy for facilitating understanding. Rose asserted that students with mathematics difficulties could achieve more in classrooms where teachers find ways to provide immediate affirming or corrective feedback. Thus, Rose tries to use everyday scenarios to introduce mathematical concepts such as solving systems of equations using elimination, and equate it with going to the movies and purchasing popcorn and cookies. Rose found that in using more common examples of mathematical concepts, students easily understood the problem and how to develop the associated equations. In her writing assignment Rose wrote:

I gave the students a task where they worked in partners to match word problems with equations and inequalities. The pairs were placed on a large piece of construction paper for stability. When the task was complete the partner group would use their cellphones to take pictures of the matches and send them to the mentor teacher for grading. Cellphone use is an integral part of my students' culture. By allowing them to take a photo of their work, they have a visual of their work available to share with their parents and to use for reference. Also, they received instant feedback from both my mentor teacher and me as we circled the room assessing their progress. (Personal Story Fall 2016)

Susan saw facilitating knowledge construction as another fundamental principle of CRMP. Susan interpreted and used the knowledge facilitation tenet as referring to the way in

which a teacher activates and builds upon students' prior knowledge, connecting the mathematics content to student lives and interests. At the beginning of Susan's school year, she encouraged and required her students to complete a student information sheet. From her students' information sheet Susan was able to use their responses to begin to familiarize herself with a general idea of her student interests, learning preferences, thoughts of mathematics, and career aspirations. Susan believes that students are motivated to learn by their various interests. In her writing assignment Susan explained how she helped to facilitate her students' knowledge and learning of polynomial functions:

As one can imagine, polynomial functions are not exactly the most exciting concepts for students to learn. I opened the polynomial unit with a 'Constructing a Box' activity. Students connected volume to cubic functions, related their personal use of boxes in their lives, and thought critically about the role constraints play in mathematics and the "real world." By activating students' prior knowledge and evoking their competitive nature, my students were very engaged and excited. (Personal Story Fall 2016)

For this tenet of CRMP Amanda engaged her students in activities that gave them the responsibility for determining what they would do in certain mathematics scenarios. Amanda believed that by giving her students the responsibility of deciding what to do her students enjoyed the mathematical concepts being discussed and developed an understanding. Amanda suggested that as a teacher, she should be able to facilitate knowledge in a manner that is relevant and meaningful to her students. Amanda asserted that the goal in this tenet is to encourage creativity. In her writing assignment, she wrote:

We just finished up a unit on circles. At the beginning, I had the students help me construct a definition of a circle. They had to pull from what they knew about circles, and eventually we had a definition on the board. In the midst of our circle unit, we completed a pie chart activity. The students had to determine a question that they wanted to survey their classmates. (Personal Story Fall 2016)

For Marlene, the facilitation of knowledge construction refers to motivating students with their interests and allowing them to be creative in problem-solving. She embraced her students'

inquiry into the usefulness of the mathematics concepts being taught. In her interview Marlene stated: “One of the most asked questions in math is “When will I use this in the real world?” I appreciate this question, and I always try to anticipate it.” Marlene believed that math without a purpose is almost impossible to learn, but with the proper motivation even difficult concepts can be overcome. In her writing assignment Marlene wrote about how she welcomed questions about math in the real world from her students. She wrote:

I think that it is inappropriate and unprofessional to ignore a student’s inquiry, or unsatisfactorily answer a question. These responses cause students to lose confidence in their teacher and reject math as a distant and inapplicable field.” Marlene suggested that math is so broad that each concept has a multitude of applications, at least one of which must be interesting to a student. She explained: “Even more often, students’ lives are affected by math in places they didn’t even realize. I love pointing these places (like medicine) out to my students so that even if they don’t enjoy math, they can appreciate it.” (Personal Story Fall 2016)

***Prejudice reduction.*** Rose believed that the material and the way it is presented to students play a role in reducing prejudice in mathematics classrooms. In her reading reflection Rose wrote:

If the material is confusing to students, I will modify it or find an acceptable substitute. I believe that the manner in which the material is presented will affect the student's self-esteem as much or more than the actual material. Students watch movies that are totally unrelated to their lifestyles and still find a way to understand the movie plots. I think that African-American students are frustrated because many of them can not relate to media that supposedly depicts their lives. (Personal Story Fall 2016)

Rose asserted that when teachers strive for rigor and cultural relevance in their instruction, they must be mindful that students do not always perceive subtle racial oppression, and therefore it is the teachers' job to question intent and provide guidance through the material that is not oppressive. In her writing assignment Rose contend that “it is reflective of an anti-African American underlying curriculum to have no posters of African and African-American mathematicians in an African-American classroom or any classroom where posters of mathematicians are displayed”.

Rose believed that teacher of African-American students who use posters in their mathematics classrooms as a way to convey messages should have posters reflecting the historical and modern influences of Africans and African-Americans on Mathematics. Rose also wrote in her assignment that: "When introducing new concepts, the mathematicians on the posters would serve as a cultural authority of the applied and academic mathematics. Additionally, I would connect these mathematicians and their contributions to known mathematicians for validation." Rose want her students to view mathematics as a part of the African and African-American culture and not a content area created by and for Europeans. Her goal is for students to understand the importance and role of mathematics in African-American and African music, art, literature, cuisine, and fashion in addition to medicine, sports, engineering, telecommunications, and architecture.

For Susan, prejudice reduction in the classroom is another critical component of CRMP. Susan refers to prejudice reduction as the methods that teachers employ to reduce stereotypes and build a level of respect for diverse cultures. Susan believes that teachers should foster an environment in which students feel comfortable and safe. This she feels is essential in cultivating positive interactions among students in their pursuit of learning. To start the school year, Susan engaged in discussion with her students about what she termed her "top classroom rule" of respecting others. Susan emphasized that her top rule of respecting each other is crucial to prejudice reduction and to ability to maintain an inclusive classroom climate. Susan also provided her students with opportunities to work collaboratively on activities in which they established group norms, that included how to provide constructive criticism, show consideration to other class members, and participate in respectful communication. Susan always make an effort to model the behavior that she expects to see in her students. Not only does she embrace all students and

their differences, but also redirect students who exhibit behavior that is disrespectful to others. In her writing assignment Susan wrote:

During an afterschool tutorial session, I overheard a few students making fun of an African student's last name. Although she laughed at the jokes of her peers, I quickly intervened and had a discussion with them to address the inappropriateness and connotation of their remarks. Even though the school is considered to be almost entirely Black/African-American, I think that many fail to realize the diversity that lies within that demographic. My students are from various backgrounds, including Guyanese, Trinidadian, Jamaican, African, and Dominican descent, just to name a few. I think that a math project or activity that would allow them to explore the cultures of one another in the scope of mathematics. (Personal Story Fall 2016)

Amanda believed prejudice reduction is one of the most important tenet within CRMP because it indicates that a classroom is positive and safe for all students. She suggested that teachers adhere to this tenet vehemently to attempt to lower the harmful and destructive stereotypes that could be present in the classroom. Amanda incorporates this tenet into her instruction through conversations. In her writing assignment Amanda wrote: "I try to do this by paying attention to the conversations that my students have while in class. Once they turn into negative or condescending, I make sure to address the issue and redirect them towards mathematics." As another strategy toward prejudice reduction in her classroom, Amanda also greeted each of her students by name, while they entered her classroom. In her interview, she explained: "it creates an environment where the students know I am intentional with them."

With regards to the prejudice reduction tenet of CRMP, Marlene saw this tenet as creating a safe and comfortable environment in which students can learn and grow. Marlene asserted that creating safe places for students is one of the most important things that teachers can do. Marlene emphasized that within classrooms, teachers need to protect students from the criticism and judgment coming from both teachers and other students who might be toxic or adverse. Marlene shared an example of what she believed to be an enactment of the prejudice reduction tenet of CRMP, and described her reaction to the situation as a success. In her writing assignment

Marlene elaborated more on her understanding of prejudice reduction by sharing the following situation involving her Black student:

More recently, one of my students was feeling discriminated against by another member of the administration. He came straight to me and told me exactly how he was feeling. I thanked him for trusting me with his experience and how it made him feel, and he said, "Of course I was going to tell you." (Personal Story Fall 2016)

Marlene emphasized that her difficulties with creating a safe and comfortable environment for all of her students come mostly from other students. Even with their junior level status in high school Marlene maintained that her students still mock each other for getting an answer wrong despite her insistence on being supportive and taking risks. Marlene tried her best to consistently redirect such conversations, but still felt inadequate. Marlene wrote:

I also regularly hear negative comments toward women (usually by males), toward African American students (usually by other African American students), and toward other marginalized groups like those with intellectual disabilities, immigrants whose first language is not English, and members of the LGBT community. I hope that eventually, I will be able to help students respect each other, creating a truly safe place in which my students can thrive. (Personal Story Fall 2016)

***Social justice.*** For Rose the importance of strengthening her students' comprehension of mathematics involved engaging them in mathematics in ways that show the relevance of mathematics. Rose maintained that her students need mathematics that will enable them to make consumer decisions, that will increase their buying power and increase access to healthy foods. Rose emphasized that an assessment of her students determined that their mathematics need or deficiencies involved the use of mathematics word problems and projects using validated data. In her writing assignment Rose explained: "These students need to know how to compare quantities and compare trends that are used to describe their community and other metro communities. As African Americans they should take responsibility for validating statistics and popular knowledge pertinent to them." As an example Rose wrote the following: "My African American



students need to know if police use excessive force more often when confronting African-American males than other groups. What do the numbers say? How do we analyze the data and draw accurate conclusions?" In her writing assignment Rose added that building students' awareness about social issues through mathematics is an important part of mathematics education:

Many believe that the eating habits of African-Americans are responsible for the high numbers of diabetics and prevalence of high blood pressure in the African-American community. Encouraging students to question whether there is a correlation between the availability of fresh fruits and vegetables, walking trails, and commuting to work, and the health problems mentioned above is critical. These questions are culturally relevant and are within the scope of middle and high school mathematics standards. By introducing these ideas for an investigation to students, we encourage exploration and inquiry within their community and daily existence. Such activity is the product of culturally responsive pedagogy. (Personal Story Fall 2016)

Susan sees social justice tenet of CRMP as a response to pressing issues in today's society, because social justice issues dominate the media and continue to be a topic of discussion in the community. Susan defined, social justice as fair and proper enforcement of laws in society regarding equality, human rights, and freedom for all people. For Susan, a big struggle in the classroom is finding ways to integrate issues of social justice into the math curriculum. One way Susan merges social justice issues and mathematics is by focusing on recent police shootings of Black males. In her writing assignment Susan elaborated on this issue by writing the following:

Over the past couple of years, more light has been shed on the killings of Black men by law enforcement. Knowing that my students are aware of and affected by issues like this, I want to create a lesson that involves statistical analysis of the data to connect the issue to mathematics. I continue to encourage my students to ask "why" and never to be afraid of questioning something they don't agree with or understand. I also encourage students to stay abreast of events, especially during the current presidential race. (Personal Story Fall 2016)

The social justice aspect of CRMP is certainly one that Susan plans to spend a great deal of time furthering her research of strategies and available resources. As an African-American Susan identifies with her students' experiences, however when incorporating social justice issues into

her classroom discussions and instructions she wants to ensure that her response isn't too emotionally charged and be able to remain objective. In her interview Susan explained: "Even as a Black woman instructing a classroom full of students who look like me, I still struggle with knowing how to begin to have a conversation about social justice issues."

Amanda understood the value of incorporating social justice issues into the classroom. For her focusing on social justice issues was a huge aspect of culturally responsive pedagogy that resonated well. Amanda expressed that social justice lessons teach students additional information than just academic content, and she believed that teaching should entail social justice components. However, Amanda admitted that she still struggles with incorporating social justice issues into her instruction. In her writing assignment Amanda wrote: "I still struggle with including extremely controversial topics, like the recent police shootings. That is a harsh topic, and I am working on approaching these type of injustices while still keeping mathematics as the focus."

For Marlene, she stated in her interview that "social justice in a mathematics classroom facilitate students' social, political, and critical consciousness while empowering them to make a difference in their community." In her writing assignment Marlene recalled an incident at her school:

A few weeks ago, I caught wind of a protest that students were planning during the school day. I was able to hear it because my students were reading it out loud – they weren't afraid of me hearing them. When I asked what it was about, several students passionately shared with me an encounter they had between the school's principal and a student about the Black Lives Matter organization. My heart immediately broke for my students, and I shared that with them. (Personal Story Fall 2016)

However, social justice is not an area into which Marlene is ready to dive into. In her writing assignment she emphasized that she finds "great difficulty in relating mathematics to political or

social issues.” Marlene emphasized that unless her students are learning about statistics she doesn’t see where the social justice tenet is applicable.

***Academic development.*** The academic development tenet of CRMP for Rose meant that instruction for her students must include built-in remediation. Given that many of her students are not involved in after school and extracurricular activities that require numerical calculations Rose uses some of her instructional time with her to students to build strong number sense and associated vocabulary. To develop her students academically Rose teach the required mathematics vocabulary in the context of her students' lived experiences. In her interview Rose explained that to connect the mathematics lessons to students' lives, she used: “instructional examples that consist of familiar experiences in students' everyday transactions such as entertainment venues, or school related activities rather than the stock market, ski trips, or building a backyard pool.” Rose asserted that she maintained high levels of expectations for her students regardless of their proficiency levels with prerequisite skills and knowledge. Rose believed that it is her responsibility to encourage her students to take ownership of their learning. Regarding what Rose considers to be students' lack of proficiency in prerequisite knowledge for her Algebra 1 course Rose wrote in her writing assignment:

They are gaining power. Even with the lack of proficiency in prerequisite knowledge, these students should be expected to perform at or above grade level. It is my goal as their teacher to gain their confidence and give them tools and instruction to succeed in Algebra I. (Personal Story Fall 2016)

Susan's believed that academic development is the ultimate goal of teaching. Susan understood that the definition of academic success differed from one educator to another. She believed academic success occurred when students develop the knowledge and skill set to understand, conceptualize, and articulate content and can display what they have learned through performance on both informal and formative assessments. During her interview, Susan expressed

that the academic success tenet encompasses components of the four previously discussed tenets, creating a perfect recipe for optimal student success in the mathematics classroom. To ensure students' academic success Susan incorporates a variety of methods to create safe classroom environments that embrace student culture and build their knowledge of mathematics: In her interview Susan stated: "I have taught using a variety of teaching methods and included many hands-on activities, technology enhanced instruction, competitive games, and real world applications." Additionally, Susan enjoyed and used a co-teaching model approach with her mentor teacher which also afforded her with opportunities to provide students with more individualized attention throughout the week, catering to students' particular learning styles. Susan encouraged and motivated her students, and reminded them that she was proud of them. In her interview, she stated: "No matter what, I want my students to know that I have their best interest at heart so I present them with the very best of myself so that they can be the very best students that they can be."

Amanda prioritized academic success over all other CRMP tenets. She emphasized that it is the teachers' responsibility to reach out to struggling students in a variety of ways to help them. In her interview Amanda shared the following as an example of how she addressed struggling students:

Normally if a student is struggling I will first off just have a conversation with them I meet with them one on one and just try to get to know them. I work with them during tutorial which is afterschool. I also show them that I care by supporting them in whatever sport they play so I've been to a lot of football games. I try different things to try to invest in their life so that they will invest in the class. (Personal Story Fall 2016)

Amanda asserted that because school is a place designed primarily for the academic enrichment of students, academic success to be a teacher's top priority. Amanda believed that one way teachers can determine their students' academic success is by their grades. However, she empha-

sized that grades in no way dictate student success. Amanda held that letter grades primarily indicate some success for one student but may indicate laziness for another. She is a firm believer that their assessment grades are more than just test and quizzes, and that teachers must assess students understanding in various ways to determine in what aspects of learning their students are achieving academic success. In her writing assignment Amanda wrote:

It seems as if teachers need to focus mainly on academic success over the other four tenets listed because it is the one we have always associated with education. Academic success means that a child has gained an understanding of the topic, and this is resulting in success. (Personal Story Fall 2016)

With regards to the academic development tenet of CRMP for students, Marlene suggested that it meant that all students are achieving with her help because she has appealed to their culture and other information that she has learned about them. Marlene asserted that to succeed in this tenant, teachers cannot give up. Yet she grapples with the idea that each student must and should be responsible for his or her education. In her writing assignment Marlene stated the following:

We have to find the one thing that will motivate our students to put in the effort. I don't feel like I have been successful in this area because I don't think that I have helped a student lacking in intrinsic motivation turn around and succeed. I still haven't quite figured out how to learn enough about so many students in such a short time to find specific connections between their lives and the curriculum to motivate them to learn math. At what point do we place some burden of responsibility onto the student? (Personal Story Fall 2016)

#### **PSMTs Perceptions of Affordances and Constraints: Theme 4**

**Theme 4: School policies and practices provided supportive and constrictive opportunities for PSMTs to become culturally responsive mathematics teachers of Black children.** PSMTs journey of becoming culturally responsive in their mathematics classroom came with affordances and constraints. Given the diversity of students, and the many changes within educational policies and school practices, teaching as a profession comes with both affordances

and constraints. In all PSMTs identified three affordances and seven constraints. All of the PSMTs experienced both.

***Affordances.*** Affordances were those practices, policies, or experiences that PSMTs found supportive in their efforts to use and integrate CRMP to teach their Black students. Mentor teachers, class time, and technology were perceived by PSMTs as affordances.

***Mentor teacher.*** Rose credits the support of her mentor teacher as being instrumental in her work with using CRMP to teach Black students. In her writing assignment Rose wrote: "My mentor teacher and I work together to ensure that students understand each of my CRMP lessons." Similarly, Susan reflected on her experiences using culturally responsive pedagogy in her mathematics classroom, to teach Black students and identified her mentor teacher as supportive toward her use of CRMP. In her writing assignment Susan wrote: "my mentor teacher is very supportive and encourages me to think of ways that I can make improvements. She allows me to let my creativity shine as I strive to appeal to student interests and learning styles."

***Class time.*** Rose identified time as an affordance when using CRMP. Based on her comparison of two of her classes, one with 50 minutes and the other with 90 minutes. Rose admitted that with her longer classes she has more time to work with her students to build their understanding and be more responsive to their needs. In her writing assignment Rose explained:

Our classes are 90-minutes long on an A-B schedule where students meet every other day versus a 50-minute daily class schedule. The 90-minute class affords us the luxury of spending additional time completing tasks, assessments and remediation. The additional time also allows us to discuss homework and review previous lessons to improve retention. (Personal Story Fall 2016)

***Technology.*** Susan credits her mentor teacher and access to technology as assets. In the classroom, we have both scientific and graphic calculators available, as well as TI-Inspires. The

materials that I needed for class projects, such as the catapult activity or constructing a box learning task, were readily available. Marlene's school went to a one-to-one this year, meaning that almost all of her students have a Surface 3 Tablet, Marlene can now provide resources for all of her students. Using the school provided electronic devices Marlene was able to give her students closed notes, video tutorials, and websites that contained multiple presentations of the mathematical concepts she taught. Marlene also used the tablets as a second instructor, and delivered her lessons in multiple ways at the same time.

***Constraints.*** Conversely, constraints were those practice, policies, or experiences that PSMTs found constrictive in their efforts to use and integrate CRMP to teach their Black students. PSMTs identified privacy of student records, standardized testing, course pacing guides, mentor teachers, time, school activities, and school discipline policies as constrictive in their efforts toward the use and integration of CRMP.

***Privacy of student records.*** Rose identified privacy of student records student privacy, preparation for standardized test. Rose believed that understanding the home and community environment of students is helpful for preservice teachers when creating the context for culturally responsive lessons. In her writing assignment Rose explained why lack of access to student records was a major constraint and inhibited her ability to learn more about her students:

As a student teacher and not teacher of record, I do not always have access to confidential student information that is valuable when implementing culturally responsive pedagogy. Information such as student Individual Education Plans (IEP), Behavior Intervention Plans (BIP), and 504 accommodations are necessary to understand the learning context and abilities of the students. Information on the home environment such as the number of siblings and ages, custody and living arrangements, the age of the student, standardized test results, and attendance assists in decisions regarding homework, the amount of reading outside of classroom versus inside of the classroom to name a few. (Personal Story Fall 2016)

*Standardized testing.* Rose is troubled by the current fixation on standardized testing. She is troubled by the constant testing and expressed concern that excessive testing and student failures negatively affect her Black students. During member checking Rose elaborated: “I recall one time when the students were testing and they appeared tired and I remembered looking at one student and he just put his head down and sighed like he had just given up”. She believed that the preparation for standardized testing is a major problem for her students. Rose explained: “I’ve noticed that when students take standardized and departmental tests, they do not possess the skills necessary to reason and analyze problems due to a lack of rigor in their daily classwork which is spent preparing for test.” Rose saw this as problematic not only for the students but also for teachers because she believed that student performance on assessments is used to interpret a teacher’s ability to teach effectively.

*Course pacing guide.* Rose also shared her concern about the course pacing guide. According to Rose, the course pacing guide can be a constraint when students do not have time for real rigor: “I believe that students need time to struggle through problems and time to receive increasingly more rigorous problems than a few basic problems before moving to the next concept area” (Writing Assignment Personal Story Fall 2016). Rose emphasized that students spend most of their time preparing for standardized mathematics assessments. Susan the course pacing guide as a constraint: “My classes are accelerated, so we move very quickly through units. I often feel the need to keep up with the course pacing limits which doesn’t leave much room for more activities and projects. I have not had the amount of time that I truly need to commit to developing lessons that are consistently culturally responsive.” For Marlene the pacing guide was a constraint because of the amount of mathematics content and standards she had to cover within short



amounts of time. In her writing assignment Marlene explained: “I have an extensive list of standards to cover in one school year. I find it difficult to get to know my students’ in such a short time when I only see them for fifty minutes, and I must teach the whole time, or I will not keep pace.

*Mentor teacher.* Unlike Marlene and Susan who identified mentor teachers as supportive, Amanda believed the presence of her mentor teacher was a constraint toward her use of CRMP. Amanda found her mentor teacher’s teaching philosophy to be constrictive toward her desire to subscribe to the tenets of CRMP. Amanda wrote: “Having another body in the room is a constraint, both teachers need to be on board. My mentor teacher has been teaching for a while, so she has the lessons from previous years. She also is a heavy worksheet teacher.” Furthermore, Amanda found the actions of the practicing teachers at her school to be disheartening and unresponsive to students. In her reading reflection Amanda wrote: “In my experience, the teachers’ lounge tended to be a place to talk openly about students in unpleasant ways. It was hurtful to hear, because how can students succeed if the ones teaching them do not believe in them.

*Time.* Amanda found difficulty implementing the practices and ideologies of culturally responsive pedagogy, because of her lack of time. In her interview Amanda proclaimed that: “It takes commitment and time to choose to be culturally responsive in the classroom. While getting my masters at the same time, there is not much time for me to fully commit to another aspect of lesson planning.” She further elaborated: “I feel like it can take over like as far as the lesson planning process goes because you’re like what can I do to pull certain concepts in and spread it throughout the learning and that can be tough.” Amanda also expressed that her students also experienced time as a constraint that inhibited them from engaging in the type of learning that CRMP provide. In her writing assignment Amanda elaborated:

Depending on what time of day it is can bring its struggles. First-period students are tired, third-period students are hungry, and fourth-period students are ready to go home. This hinders their ability to receive culturally responsive pedagogy or any teaching at all. We are constant motivators. (Personal Story Fall 2016)

*School activities.* Amanda also mentioned extracurricular activities such as sports, as a constraint that hinders students' abilities to fully engage in CRMP learning. In her writing assignment Amanda explained:

Another constraint I have observed is sports. I played sports in high school, and it was wonderful to have permission to miss class. Now I am on the opposite side, and it's hard to get participation from the students when they know they will be called to load the bus soon. Sports also hinder their ability to complete their homework. Many students have told me that their practices have lasted for an extreme amount of hours which hinders their capability of completing homework which then hinders their understanding of the concept. (Personal Story Fall 2016)

*School discipline policies.* Amanda shared that frequent disciplinary actions interfere with her students' opportunities to learn mathematics in her classroom. In her writing assignment Amanda stated: "Far too many of her students are removed during instruction to address infractions that are often minor but due to school policy require students being removed and addressed by the school's resource officer." Amanda contend that the excessive pulling out of and removal from her mathematics instruction interferes with her students' motivation and desire to learn as well as their ability to keep up with the work due to excessive absences, missed instruction and a deliberate attempt to avoid being called out of class by administration or the school's resource officer. Amanda used her writing assignment to give a clearer picture of what goes on at her school. She wrote:

Disciplinary situations can hurt academic success. For example, I have a very troubled student. He is always suspended. He was actually in class one day, working hard when the resource officer pulled him out of class to let him know he would be suspended for four days and converse about the situation. I cannot control that, but it takes away from instruction time. (Personal Story Fall 2016)

## Summary

In this chapter I presented a case study of four preservice secondary mathematics teachers using their own voices to share their personal stories chronicling their experiences using CRMP practices. My personal experiences with culturally unresponsive teaching has left me with an understanding of the need and urgency for teacher educator programs to produce culturally responsive teachers. Therefore, when I framed my study I wanted to ensure that the theoretical lens used would support the need for educators to become more conscious of their own cultural identity and the social culture around them. The findings of this research study demonstrate the importance of preparing teachers to be culturally responsive. This study is a start toward a process of adequately preparing mathematics teachers for diverse classrooms and will help combat unfortunate experiences of Black children who are subjected to discontinuity between their cultural experiences and what they experience at school. The findings of this study hold imperatives for teacher education programs, mathematics teachers, and mathematics education as a whole. Analysis of the study's data indicates that there are implications and suggestions for research, policy, and practice, and while this chapter focused on four preservice teachers, the next chapter briefly discusses the study's findings and the bigger picture by examining further the implications a study such as this one has on teacher education programs and current public policies and practices.

## CHAPTER 5 DISCUSSION

### Discussion

The study examined the integration and use of culturally responsive mathematics pedagogy in four preservice secondary mathematics teachers' reflection and practice. The study further explored how teachers negotiated their experiences teaching Black children mathematics using CRMP ideologies and practices as well as sought to identify affordances and constraints PSMTs experienced. PSMTs voices were heard and their writings were analyzed to gain understanding into their perceptions of CRMP ideologies and its impact on their teaching experiences. Analysis of the study's data identified aspects of teaching such as culturally responsive pedagogy that teacher education programs could capitalize on to improve mathematics teaching and learning for Black children.

In examining the PSMTs integration and use of CRMP to teach Black children 4 themes emerged. Three of the emerged themes described PSMTs perceptions of how they negotiated their experiences using CRMP to teach Black children: Theme 1: Inter- and Intra-personal race relationships both inside and outside of the mathematics classroom were part of PSMTs negotiated teaching experiences with Black children; Theme 2: Immersion in CRMP learning activities fostered PSMTs awareness of racial and cultural issues in mathematics teaching and learning; and Theme 3: PSMTs understanding of CRMP tenets impacted how they implemented CRMP to teach Black children. Additionally, one theme emerged that addressed PSMTs perception of affordances and constraints that impacted their use of CRMP to teach Black children: Theme 4: School policies and practices provided supportive and constrictive opportunities for PSMTs to become culturally responsive mathematics teachers of Black children.

In presenting discussions of findings from qualitative studies it is important to note that interpretation is paramount (Merriam, 2016). Using CRT lens an important takeaway of the study's findings is that all the PSMTs in this study, through their stories, showed a perceptive understanding of how race and culture impact educational practices and policies. PSMTs negotiations, affordances and constraints were all a result of the relationships, interactions, and social conditioning they experienced. Primarily, PSMTs inter- and intra- personal relationships were salient forces both inside and outside of their mathematics classrooms. PSMTs interpersonal relationships can be conceptualized and described in terms of their in- and out- of school associations while their intrapersonal relationships can be thought of as their own personal epistemology, feelings, and attitudes from within. These relationships were fundamental to their level of awareness of racial and cultural issues in mathematics education, governed their interpretation and use of CRMP tenets, and impacted their responses to school policies and practices.

It has become increasingly evident that interpersonal and intrapersonal relationships within mathematics classrooms can account for how well students learn (Cooper, 2010; Stipek, 2000). Supporters of culturally responsive pedagogy maintain that a significant part of being culturally responsive in mathematics classrooms involves teachers spending more time engaging students in conversations and actions that make students feel more valued and supported (Rychly & Graves, 2012). More so, evidences from the study's findings, suggest that PSMTs inter- and intra- personal race relationships were part of larger dominant social and cultural assumptions regarding race, culture, and intelligence. PSMTs' social conditioning were critical forces that impacted how they interacted with their Black students. For example, Amanda's interpersonal relationship with her family and friends who questioned whether Black students were capable of

learning mathematics is an example of how social conditioning and historically held deficit views of Black children impact teaching and learning of mathematics for Black students.

Historically, deficit views and narratives about Black people have included, but are not limited to, negative stereotypes about intelligence and family dynamics. Akin to Amanda, Marlene also held cultural deficit views about Black students. Both Amanda and Marlene saw their students as being from broken families, lacked examples of love, had parents that were too busy to care, had unresponsive parents, and were weary of raising expectations of their Black students. Perhaps Amanda and Marlene are unaware that they possess deficit beliefs and perceptions about Black students, and their families. However, consequent indoctrination into negative and bias dominant social and cultural assumptions about the intelligence and family life of students of color is problematic. Deficit perspectives cause educators to have lower expectations (Toldson & Johns). Furthermore, Amanda and Marlene's psychological trapping (Moss, Bryant, & Zijdemans-Boudreau; 2015) of their students that render them substandard or non-traditional could serve as negative outcomes. In the next section is a discussion of how this study's findings align to literature.

### **Connections to Literature**

In Chapter 2 studies were reviewed (Battey, 2013; Bonner & Adams, 2012; Bright, 2016; Hernandez, Morales, & Shroyer, 2013; Geist, 2015; Leonard & Moore, 2014; Rubel & Chu, 2012; Simic-Muller, Fernandes, Felton-Koestler, 2015; Jackson, 2013; Waddell, 2014; Wager, 2012; Ukpokodu, 2011) that examined teachers' experiences as they ventured to become culturally responsive in mathematics classrooms. This study aligned with the reviewed studies in several ways. For example, in all the reviewed studies, including this study, the integration and use

of CRMP ideologies and practices had significant impact on how teachers related to their students. To show how this study connects to the literature discussed in Chapter 2 and published scholarly literature that is referenced throughout the study, I will discuss the overall experiences of PSMTs, in terms of their negotiated experiences, affordances, and constraints, that PSMTs identified as impactful toward their integration and use of CRMP to teach Black children.

**PSMTs Negotiated experiences.** Findings from the study, themes one and two, regarding inter- and intra- personal race relationships both inside and outside of the mathematics classroom and immersion in CRMP learning activities to foster PSMTs awareness of racial and cultural issues in mathematics teaching and learning were part of PSMTs negotiated teaching experiences with Black children. In negotiating their experiences, PSMTs in this study reported impactful involvements, interpersonal and intrapersonal race relations, awareness of racial and cultural issues, and school practices and policies that ultimately shaped their teaching experiences with Black children. PSMTs interpersonal and intrapersonal race relationships stemmed from their background experiences and were an important part of their negotiations inside the classroom. PSMTs background experiences, overall, contributed to their attitudes and expectations toward their Black students. Aligned with Waddell (2014) a major finding of this study is that PSMTs personal racial and cultural beliefs served both as affordances and constraints in their mathematics classrooms. Waddell maintain that because teachers bring their own personal beliefs, culture, and learning practices into their classrooms it is important for teachers to think about how such beliefs and habits can interact with teaching and learning mathematics. Additionally, like Jackson (2013) and Ukpokodu (2011) this study also found affordances such as PSMTs

knowledge and acceptance of CRMP as an equity pedagogy and constraints such as cultural mismatch, and tailoring mathematics instruction in preparation of standardized testing impacted integration and use of CRMP to teach Black children.

**PSMTs affordances using CRMP.** A finding of this study, theme three, is that PSMTs understanding of CRMP tenets impact how they implement CRMP to teach Black children. As the PSMTs learned about the different tenets of CRMP that were utilized in this study, they each developed their own interpretation and eventual ways of embedding CRMP practices in their classrooms. This finding aligns with Hernandez et al. (2013), who maintain that interpretation of CRMP tenets is crucial to how it is used and implemented in classrooms. Stemming from their interpretation of the content integration tenet, most of the PSMTs perceived their ability to connect mathematics instruction with their students' lives as an asset toward making mathematics responsive.

***Connecting mathematics.*** PSMTs sought ways to connect mathematics to their students' lives. Through the content integration tenet of CRMP, the PSMTs incorporated food, music, fashion, dance, and sports into their mathematics instruction as a way to connect mathematics to their students' lives and to keep their students engaged. This finding aligns with Bonner (2012) who opined that a common practice of CRMP is to connect mathematics with students' everyday practices. One particular activity that two of the PSMTs used to garner the attention and interest of their Black students was 'Trashketball.' Like the name suggests 'trashketball' is an activity similar to the sport of basketball whereby students use trashcans as hoops to toss in balls of paper. PSMTs saw the use of 'trashketball' as a way of being culturally responsive as it was similar to a sport (basketball) that their students could relate. Although the game of basketball transcends race, the percentage of Black children in each teacher's classroom was greater than any



other race, influencing the teachers to use basketball as a motivation to learn mathematics. Culturally, in the U.S. basketball has become a sport that is currently dominated by Black athletes. The use of ‘trashketball’ is a start toward possible vibrant classroom discussions about mathematics.

**PSMTs constraints using CRMP.** Within this study, PSMTs experienced constraints that inhibited their abilities to embed culturally responsive mathematical practices in their classrooms. Theme four of the study makes evident that school policies and practices provided both supportive and constrictive opportunities for PSMTs of this study to become culturally responsive mathematics teachers of Black children. The constraints were in the forms of cultural mismatch between PSMTs and their students, PSMTs view of mathematics as culture free, PSMTs attitudes toward their Black students, PSMTs personal biases, and school culture in the forms of policies and practices. The constraints were instrumental in how PSMTs implemented and used CRMP to teach their Black students.

***Cultural mismatch.*** The cultural mismatch between White PSMTs and their Black students and the constrictive hold such a mismatch had on their ability to connect mathematics to their students’ lives, or build relationships with them align with Norman, Ault, Bentz, & Meskinen (2001); Irvine (2010); Ladson-Billings (2006); and Howard (2008) who maintain that cultural mismatch serve as a challenge for cultural hybridity and creates a barrier between effective CRMP implementation and teacher-student relationships. Both of the White PSMTs shared how their differentness was an obstacle impacting their teacher-student relationship. Battey (2013) assert that teachers’ perceptions about issues relating to race and culture is one of four dimensions in which teacher-student relational interactions mediate access to mathematics. Marlene and

Amanda's perception about the cultural differentness of their Black students made them uncomfortable in engaging their students in social justice issues as it relates to CRMP practices. Additionally, the findings line up with Tinkler and Tinkler (2013) report that preservice teachers' perceptiveness and receptiveness of diverse students' impact what and how they teach. This finding of racial and cultural differentness as an obstacle for developing teacher-student relational interactions indicates that teachers' sociocultural perspectives are contributing factors in the way teachers use CRMP to teach mathematics to Black children.

***View of mathematics as culture free.*** Another finding of the study was that PSMTs struggled to align the cultural referents of their Black students with mathematics. This struggle possibly stemmed from their view of mathematics as culture free. As Leonard and Moore (2014) reported there is a resistance to the use of culture in mathematics. The general belief is that 'math is math' (Leonard & Moore, 2014) therefore race and culture do not matter for mathematics teaching and learning (Nasir, 2016). Yet teachers are aware that their students use mathematics daily and within their own everyday practices. When teachers begin to view learning as inherently cultural (Nasir, 2016) development of students' own knowledge of mathematics becomes the base for moving mathematics teaching and learning forward. Immersing PSMTs in CRMP ideologies and practices can move teachers towards a different view of mathematics.

***Teacher attitudes toward Black students, impact mathematics teaching and learning.*** Another finding evident from the data was that PSMTs attitude toward their Black students impacted their integration and use of CRMP. This finding aligns with Dunleavy (2015); Geist (2015; Greenfield (2016); Keller Boudreaux (2016); Ramirez et al. (2016) and Williams, Edwards, Kuhel, & Lim (2016). Implicit racial and cultural stereotypes that the participants embraced or rejected influenced the extent to which they incorporated students' cultural referents in

their classrooms including the types of values they enforced and the learning activities they utilized in their classroom. More so, the finding echoes Dunleavy (2015) who asserted that in negotiating experiences in classrooms a teacher's racial and cultural awareness impact their perspectives of CLD students' mathematical abilities as well as their own approach to mathematics instruction. PSMTs attitudes regarding race and culture impacted their teaching experiences significantly. Their attitudes toward their Black students propelled them to maintain high expectations of students, promote academic development and to question gaps in mathematics performances. The concept of building students' academic development is an ideology of CRMP, and is often a result of high teacher expectations. As Dunleavy (2015) suggested, through clear communications about what they expect students to know and do, teachers' expectations of students are fundamental to sustaining students' mathematics authority. In line with this conceptualization that teacher attitudes toward their students shape their expectations of students' academic development this study showed that developing PSMTs awareness about racial and cultural issues likely contributes to PSMTs use of CRMP and can serve either as an affordance or constraint in their mathematics classrooms. All of the participants experienced and encountered cultural and racial matters during their practicum teaching experiences. Even though they each responded differently to the cultural and racial situations some of their actions and quotations speak to their value and promise as future educators.

***Personal biases.*** In the current study, personal biases in the form of discomfort with teaching for social justice was evident. PSMTs immersion into CRMP learning activities fostered an awareness about how racial and cultural issues impact the mathematics education of their Black students. The awareness had varying effects on PSMTs teaching practices that helped

framed their Black students' mathematics learning. It is well-reported (e.g., Achinstein & Ogawa, 2012; Pittman, 2010) that teachers' view of race and culture impact what and how they teach. This study's data showed that both of the Black teacher participants, Rose and Susan, used their similarities to their Black students, as well as their perceptions and experiences with their students to positively frame their expectations of their student's mathematics ability. Conversely, an analysis of the study's data showed that both of the White participants, Amanda and Marlene, struggled with their racial and cultural differentness which impacted their use of CRMP. As part of their personal bias both Amanda and Marlene struggled with using mathematics to instruct their Black students in areas of social justice. This finding echoes Simic-Muller, Fernandes, and Felton-Koestler (2015) study which found over 97% of preservice teachers were uncomfortable with incorporating social justice issues in their classrooms.

***School culture.*** The culture of the schools had a significant impact on PSMTs use of CRMP and could be viewed in two ways: 1) structurally biased; and 2) unbiased. Bauml (2015) suggest that structural biases can include policies and practices of schools that undermine teachers' abilities to facilitate learning. In this study structural biases within school culture included: mentor teachers, test preparation, class time, school activities, school discipline policies, course pacing guide, and privacy of student records. While of the elements of the schools' culture listed are important mentor teachers, test preparation and school discipline have been most detrimental to teaching and learning mathematics.

***Mentor teachers.*** Mentoring of new teachers is an important part of teacher preparation and induction programs and is intended to help new teachers become educational professionals (Ingersoll & Strong, 2011). In this study, mentor teachers were regarded both as an affordance

and constraint. Three mentor teachers were identified as supportive when they allowed, encourage and supported PSMTs integration and use of CRMP. Conversely, one mentor teacher was identified as a constraint by the PSMT because of the mentor teacher's over use of old lesson plans and refusal to change teaching philosophy. The constrictive mentor teacher was described by the PSMT as using old lesson plans to instruct Black students and as "a heavy worksheet teacher." This mentor teacher's practice of relying on old lesson plans and worksheets as means of curriculum pacing and guides to teach and learn mathematics align with Pellegrino, Mann, and Russell (2013) and Bright (2016) who contend that far too many mathematics teachers are relying on mathematics text as their primary lens through which they teach mathematics. However, if mentor teachers continue to over use old texts such as lesson plans and worksheets to influence the scope and sequence of mathematics content (Pellegrino et al., 2013) instead of encouraging culturally responsive mathematics pedagogical practices (Bonner, 2014; Bright, 2016) then mentor teachers will serve as a major obstacle in PSMTs integration and use of CRMP.

*Standardized test.* While there are no mandates for common statewide assessments within the current Race to the Top initiative, many states have adopted assessments to compare student performances between states, and potentially bargain for more funding from the federal government. States that show improvement in student performance are funded well. Conversely states that have poor performing students do not get as much funding, and are penalized. This 'race' has left schools in desperate positions. Many have taken on drastic measures that include attaching student performance on standardized tests to teacher evaluations, and pay. As a response to expectations of schools many teachers have resorted to 'teaching to the test', and 'drill and kill' (Achinstein & Ogawa, 2012; Bauml, 2015; Frank & Williams, 2016; Ukpokodu, 2011). Test preparation which is embedded into the course pacing guide served as a huge constraint to

PSMTs integration and use of CRMP. This finding align with Ukpokodu (2011) who assert that school culture fixated on preparing students for high-stakes standardized tests limited the scope through which mathematics teachers could be culturally responsive. PSMTs in this study were expected to cover “extensive list” of mathematics standards in order to prepare their students for testing.

*School discipline policies.* School discipline in the use of suspension and expulsion are forces that shape the relationship between prison and education and create fundamentally different experiences for Black and White children (Meiners, 2007; Porter, 2015). One of the PSMTs identified the constrictive practice of school discipline as limiting her Black student’s access to mathematics instruction. This finding align with Battey (2013); Gregory et al. (2016) and Simmons-Reed & Cartledge (2014) who assert that when students are continuously targeted and removed from classroom instruction they become trapped in a cycle that removes them from needed mathematics instruction. Continuation of excessive disciplinary actions against Black children will limit the scope through which PSMTs can be culturally responsive.

In this study, the need to examine and understand both supportive and restrictive mechanisms that impact the use of culturally responsive pedagogical practices in mathematics classrooms was supported. All of the findings reiterates the importance of immersing prospective secondary mathematics teachers in culturally responsive pedagogy for the classroom. My findings, in many ways, agree with Battey (2014), Bright (2016), Bonner (2014), and Leonard and Moore (2014) studies on the experiences of teachers who venture to become culturally responsive in mathematics classrooms. Namely, as with affordances and constraints, the preservice teachers in this study, used their own understanding of the importance of critical pedagogy such as CRMP to serve as an affordance (C. Jackson, 2013), while their racial and cultural identity in the form of

cultural mismatch served as a constraint (Dunleavy, 2015). Other findings of the data also suggest that impactful experiences such as interactions with mentor teachers and school norms, practices, and materials also serve as affordances and constraints. These affordances and constraints from the data findings align with Bauml, (2015); Bright, (2016); and Ukpokodu, (2011). At the same time, the study in several ways demonstrates two things: a) the novel interest these preservice teachers show in becoming culturally responsive pedagogues in their secondary mathematics classrooms; and b) the impactful experiences prospective teachers share during their time at initiating schools.

Theoretically, this research provided information on the issues of CRMP particularly on the strengths and vulnerability of PSMTs who venture to use CRMP with fidelity in their mathematics classrooms. Understanding CRMP ideologies and actually utilizing culturally responsive practices are not always reliable and the discrepancy between understanding and practice is far too common. PSMTs as novice educators struggle with the adaptation of their new school environment and the use and integration of CRMP practices (Leonard & Moore, 2014; Roofe, 2015; Waddell & Ukpokodu, 2012). Through exploring the experiences of PSMTs as they strived to integrate culturally responsive teaching practices in their mathematics classroom, and examining the affordances and constraints they identify, this work went beyond discussing CRMP as a viable option. This work is motivated by the promises of what can be achieved when mathematics teachers become intentional culturally responsive pedagogues.

In sum this study found: 1) PSMTs interpersonal and intrapersonal race relationships impacted their use of CRMP to teach Black children; 2) developing PSMTs awareness about racial and cultural issues likely contributes to PSMTs use of CRMP to teach Black children and can

serve either as an affordance or constraint in mathematics classrooms; 3) PSMTs own understanding of CRMP tenets impacted how they implement CRMP to teach Black children; and 4) school culture in forms of structural policies and practices can serve as biases that impact PSMTs use of CRMP.

## **Implications**

Perhaps the most important take away from the analysis of this study's data and discussion is that interpersonal and intrapersonal race relationships both inside and outside of the mathematics classroom as it relates to how preservice teachers situate themselves racially and culturally serve as impetus to how CRMP is used, which ultimately impact teaching and learning of mathematics. Therefore, we must regard past and current experiences of preservice teachers as valuable. Additionally, recognition that racial and cultural matters affect mathematics education insofar as it relates to how teachers see differentness as an obstacle is important. Thus the main implication from this study for teacher education programs abounds in the development of culturally inclusive mathematics teachers who, through an examination of their own biases, unequivocally, include culturally responsive mathematics pedagogy as part of their pedagogical practices. Recent studies (e.g., Averill, Anderson, & Drake, 2015; Jackson, Appelgate, Seiler, Sheth & Nadolny, 2016) stress that teacher preparation programs must change in response to the changing demographics of U.S. schools and become more deliberate in their approach toward engaging preservice teachers in critical pedagogy such as culturally responsive pedagogy. The present study emphasizes that importance by examining four preservice secondary mathematics teachers' personal stories of their integration and use of culturally responsive pedagogy after being immersed in CRMP professional learning activities. Although the four participants' use of



CRMP cannot be generalized, their experiences provide teacher education programs with insights into how to better prepare prospective teachers for diverse classrooms. In line with the study's inquiry, my findings may be applicable to improving mathematics outcomes for Black children.

Cued by my analysis of this study's data, and considering the urgent call to prepare teachers to meet the needs of Black students, I raise two questions relative to how teacher education programs prepare prospective teachers. The first question is, considering that culturally responsive pedagogy serves as a viable option to teach mathematics, how should teacher educator programs respond? The second question asks how can teacher educators begin to address the discrepancy between prospective teachers' understanding of CRMP ideologies and the ways in which CRMP tenets is actually utilized into practice? These questions posed are not new. Over the years, research scholars (e.g., Gay, 2002; Jett, 2012; Irvine, 2010; Ladson-Billings, 1995a; 1995b; Lambeth & Smith 2016) have examined the need for significant changes within teacher preparation programs and have called for significant changes in response to the changing demographics of U.S. schools and for teacher educators to become more deliberate in their approach toward engaging preservice teachers in critical pedagogy such as culturally responsive pedagogy.

Although the four participants' experiences using CRMP cannot be generalized, their encounters serve as evidence into the need to [re] conceptualize teacher preparation programs for diverse mathematics classrooms. In addressing each question, it is necessary to examine policies and practices that impact mathematics teacher education programs, mathematics teachers, and mathematics education. As implications of this study, I call attention to the growing need for teacher preparation programs to: a) create a culture of learning unafraid of comparing teaching

practices of Black and White preservice teachers of underserved students, through an examination of their affordances and constraints utilizing CRMP, b) a critical examination of how preservice teachers interpersonal and intrapersonal relationships impact teaching and learning of mathematics; c) examine prospective teachers personal biases with regards to race, culture, and diverse students; d) for teacher educators to foster environments that embrace appropriate resistance toward structures, policies and practices that constrict teachers' ability to engage in culturally responsive pedagogical practices; and e) teacher educators need to realize that CRMP is a worthwhile pedagogy for teaching mathematics. In what follows, I further elaborate on each of these implications as they relate to teacher preparation programs in light of the findings of this study.

First, teacher educators need to embed critical examinations of preservice teachers' interpersonal and intrapersonal race relationships both inside and outside of the mathematics classrooms as part of preparing secondary mathematics teachers for diverse classrooms. Examinations of background experiences impacting teachers' mathematics interest and identity acknowledges teaching philosophies as a subset of a person's sociocultural view (Stinson & Powell, 2010). As illustrated in the findings of this study, preservice teachers' interpersonal and intrapersonal race relationships in forms of background experiences and cultural differentness as obstacles to building relationship with their Black students were crucial in their journey of becoming culturally responsive pedagogues. Gay (2013), Russell and Russell (2014), and Warren (2013) research studies have suggested that the background experiences, racial and cultural views, as well as, interactions of teachers play an important part in determining how they negotiate the various demands on their professionalism with their professional and personal identities.

Adding to the literature, the participants in this study showed that their journey to use culturally responsive mathematics pedagogical practices though challenging should be embraced, systematically, in-depth and with fidelity, throughout teacher preparation programs to help better prepare teachers for diverse classrooms. Teacher educators need to ensure that the policies and practices they put in place reinforce their goals for prospective teachers, align with their beliefs about K-12 mathematics education for diverse students, and are supported by research findings such as this study.

A second implication of the study is that teacher educator programs need to examine prospective teachers' feelings, about and success with, diverse students through an exploration of teachers' intersectionality of race, culture, lived experiences and content knowledge. National reform agenda tend to focus on test scores, and dominant narratives about mathematics performance of students of color (Martin, 2012) without much attention given to how racial, cultural, and historic biases inherent in both the U.S. education and social operating systems and teachers of such children impact their learning. However, findings of the study including the cultural mismatch between PSMTs and their Black students, PSMTs view of mathematics as culture free, and the personal biases inherent in PSMTs attitude toward their Black students all demonstrate more closely how racial and cultural matters impact teachers' actions and discourse toward students' of color mathematics experiences.

Additionally, PSMTs discomfort and reluctance to address social justice issues conflict with CRMP recommendations that mathematics instruction for Black children should take into account historical marginalization and present-day policies and practices that do harm to Black children (Bright, 2016; Jackson, 2013; Jett, 2012; Leonard & Moore, 2014). Thus teacher educa-

tion programs should care about race and culture (Nasir, 2016). Moreover, within teacher education programs attention should be given to the perspectives of prospective teachers (Gay, 2013). Having the experiences of two African American teachers and two White teachers in the study disclosed how race could impact CRMP teaching experiences. The findings suggest that teachers of color who serve students of color are motivated by their own personal experiences and connections with their students to improve the educational outcomes of their students of color. Note that the data did not prove that White teachers from homogeneous backgrounds are least likely to become culturally responsive pedagogues. Nor did the study's findings prove that African American teachers are more suited to teach Black children. However, the experiences of participants Rose and Susan who are African American teachers align well with Achinstein and Ogawa (2012), and Villegas and Irvine (2010) studies which asserts that the commonalities of race and culture between teachers of color and their students of color impact their use of culturally responsive practices. Furthermore, findings of this study suggest that when teachers of Black children have a solid sense of the historical educational disadvantages Black children have faced throughout the U.S. education system, their appreciation for becoming culturally responsive empathetic pedagogues increase. This aligns with Buchanan (2015), and Simic-Muller, Fernandez, & Felton-Koestler (2015) who suggest that teachers who understand how policies, practices, racial, and cultural experiences work to constrict mathematics learning experiences of students of color are more determined in their efforts to be critical empathetic culturally responsive pedagogues.

Therefore, addressing the lack of diversity in preservice teachers in teacher preparation programs should become a priority. Moreover, from the study's data it might be concluded that racial and cultural views are all embedded in preservice teachers' interest in content, identity,

ownership and agency within the process and product of teaching diverse students. Therefore, in preparing teachers for increasingly diverse classrooms the bridge between knowledge of content, pedagogy, background experiences, view of racial and cultural dynamics and interactions are inextricably linked (Gay, 2013). To reiterate, the study's findings do not suggest that White teachers are least likely to become culturally responsive pedagogues, instead akin to Milner (2010), this study maintains that teachers of students of color must be afforded opportunities to develop cultural competence in order to build cultural congruence. Like students, teachers bring with them lived experiences that should be examined. Lived experiences help to formulate sociocultural views that is often exhibited in various ways including one's ability to engage in culturally responsive teaching.

For many Black children success in schools is often determined by the coupling of teachers' unconscious biases and institutional racism (Ani, 2013; Battey, 2013; Martin, 2013; Irvine, 1999; 2003; Spencer, 2009). Recent data shows that the current mathematics teaching force is over 86% White with only 6.4% Black and 6.2% Latino and with the changing U.S. demographics Black and Latino children now make up over 50% of the student population (Maxwell, 2014; NCES, 2016). Therefore, in line with the study's inquiry teacher educator programs need to foster an environment where all teachers examine their personal views and representations about diverse students through personal reflections and autobiographies. This practice affords teachers and teacher educators with opportunities to build a community of professionals with the awareness of their own biases and subjectivities that impact their teaching. There is a troubling comfort and acceptance within teacher education programs that because of a multicul-

tural education class that is required of teachers enough is done to address racial and cultural issues impacting education (Puchner & Markowitz, 2015). However, the findings of this study show what we can unearth once we scratch the surface.

A third implication of the study which aligns with other research studies, is that teacher educator programs need to assist prospective teachers in ways that afford them with techniques and knowledge of how to carry out appropriate resistances to standardized curricular mandates that impede upon their abilities to be culturally responsive. As evidenced in this study and akin to Kitchen, Ridder and Bolz (2016), as well as Ukpokodu (2011) research studies, teachers are being stripped of opportunities to be culturally responsive due, in part, to two factors: a) mandatory preparation for required standardized test as determined by educational policies, and b) large class sizes that are often a result of student retention from low performances on standardized tests. At the national level schools enact with federal, state, and local policies through a series of national objectives and standards as determined through No Child Left Behind (NCLB) (2001), and Race to the Top (RT3). These enactments and common standards occur as both goals and measurable standards, which are embedded into the written local, state, and school curriculum and can be seen in teacher instructional methods, materials, teaching and learning guides for schools. Like NCLB, RT3 has left an indelible mark on the current state of American education. RT3 allow states to compete for federal dollars by enacting certain education reforms, and provide assistance to schools through grants that serve over 22 million students and influence the teachings of over 1.5 million teachers in more than 40,000 schools.

NCLB and RT3 allow states to improve their chances of obtaining funds by adopting shared education standards with other states. While some states have benefited from standardized

testing incentives many have felt the wrath of failure, embarrassment, and legal issues. The policies enforced, and fear of losing funding have led to dishonest and destructive practices of schools, in particular schools that largely serve African American and Latino children (Chan, 2013; Sleeter & Stillman, 2013; Valenzuela, 2013). Some of the practices include labeling students as incorrigible, uneducable, and unsalvageable (Darling-Hammond, 2010; Noguera, 2003), and as evidenced in this study focus solely on test preparation (Frank & Williams, 2016; Ukpokodu, 2011). This ‘race’ has left underserved ‘races’ within U.S. public schools in desperate positions. Therefore, the identification of preparation for standardized testing as a constrictive factor in teachers’ use of CRMP practices should be a concern for teacher education programs seeking to improve K-12 mathematics experiences of historically underserved children.

Fourth, teacher educators need to realize that CRMP is a worthwhile option for teaching mathematics. CRMP practices should therefore be inculcated into teacher education programs (Bonner, 2014; Roofe, 2015; Tawfeeq & Yu, 2012) with fidelity, and considered as one of the needs of preservice secondary mathematics teachers’ preparation. As such, a concerted effort should be taken on the part of teacher educators to initiate a discourse with K-12 schools, mentor teachers, and those within higher education who are interested in enhancing the mathematics experiences of diverse students (Frank & Williams, 2016). To start teacher preparation programs could work with mentor teachers in K-12 to enhance the mentor teachers’ knowledge of CRMP. Mentor teachers should understand the value, importance, and commitment to CRMP practices, because if mentor teachers do not understand CRMP, constraints may arise for PSMTs. Such discourse could lead to a cogent understanding of what preservice teachers need, to be culturally responsive in mathematics classrooms. Additionally, teacher preparation programs could begin to incorporate Black studies courses as part of their curriculum. Incorporation of Black studies

courses into the preparation of teachers, will afford teachers opportunities to address race, racism, stereotypes, and personal biases that can negatively impact the teaching and learning of mathematics.

For instance, within this study of examining preservice teachers' use of culturally responsive pedagogy in their mathematics classrooms prospective teachers were engaged in culturally responsive professional learning activities that required them to read, act, and discuss racial and cultural issues that involved addressing biases, challenging stereotypes and building awareness of inequities. Participants were assigned readings, given time to embed the concepts from the readings, and discussions were continuous throughout their practicum. More importantly, in addition to adapting this expectation of reading, understanding, and embedding culturally responsive practices throughout teacher education programs, it might be fruitful to initiate statewide, or nationwide collaborative efforts whereby specific aspects of culturally responsive pedagogical practices are explicitly emphasized as necessary in the context of teacher education programs, and Black studies courses are valued as mandatory components of the teacher preparation programs designed to prepare culturally responsive pedagogues.

It is appropriate to note that such a collaboration would not be easy due to constraints that include, but are not limited to, institutional policies. However, deliberate production of culturally responsive mathematics pedagogues on deck (Jett, 2013), can have a positive rippled effect for many underserved communities within the U.S. and society at large as it relates to better social outcomes, economic savings, healthier and productive lives, and less incarcerations. Additionally, preparing prospective teachers to be culturally responsive pedagogues, could affect teacher



attrition rates, and lead to more critical empathetic teaching which remains a valuable and indispensable resource that is crucial in the mathematics experiences of historically underserved children such as Black children.

### **Suggestions for Future Research**

There are many directions in which future research into matters involving preservice secondary mathematics teachers that can be pursued. First, it seems practical from the findings that research analysis comparing teaching practices of diverse preservice teachers of underserved students examining their successes and plights of utilizing CRMP is needed. This investigative process should foreground racial and cultural matters with an emphasis on critical empathetic teaching practices. If teacher educator programs are committed to preparing culturally responsive mathematics pedagogues then surely there must be explorations of how dominant views about race and culture permeates teachers' thinking, views and ultimately what and how they teach. Probes into internalized stereotypes about diverse students such as Black children can lead to the discovery of how teachers view the mathematics abilities of their students. In addition to probing preservice teachers, ideas and pedagogical practices from successful teachers of marginalized students should also be solicited. There is much to learn from culturally responsive pedagogues who are successful teachers of culturally and linguistically diverse students. Prospective teachers of diverse students should be given time to observe, interview and interact with successful culturally responsive pedagogues to share viewpoints on how to meet the mathematical needs of students of color. The observations, interviews and interactions with successful culturally responsive mathematics teachers is not to produce scripted manuals that prospective teachers can receive and become culturally responsive pedagogues themselves. Rather the process would serve as ways in which teacher educators promote a culture that seeks to transform current

teacher preparation programs into more culturally inclusive and transformative spaces for prospective teachers.

Additionally, research from other settings are needed before any general conclusions can be made regarding the findings of this study. For example, future studies can be conducted to show how preservice teachers' background experiences which helped to shape their mathematics interest and identity often, in different ways, impact their teaching of mathematics. Few would argue that teachers teach their students similar to the ways in which they were taught. Therefore, one can conclude that teachers who were taught within systems that held up negative stereotypes about underserved students might have or uphold similar negative stereotypes about such students. Thus, there is a need to explore how internalized stereotypes about race, culture, language, and socioeconomic status impact the teaching and learning of mathematics. These propositions are merely starting points toward producing culturally responsive pedagogues that can ignite and sustain the mathematics brilliance of underserved students such as Black children. Although the study has demonstrated how four teachers negotiate their experiences using CRMP to teach secondary level mathematics it is not without limitations

### **Final Thoughts**

Overall, my work attempted to capture and examine the experiences of four preservice secondary mathematics teachers as they ventured to use culturally responsive mathematics pedagogical ideologies and practices in their mathematics classrooms during their practicum. Based on the literature and aligned with my findings I assert that by tapping into how PSMTs negotiated their experiences using CRMP to teach Black children mathematics and highlighting affordances and constraints of their journey, this examination is empowering and impactful for

teacher education programs, teachers, and mathematics education. The ways in which the participants negotiated issues pertaining to race, culture, educational policies and practices within their respective school systems while attempting to be culturally responsive within their classrooms adds to conversations of how to prepare teachers for diverse classrooms. Furthermore, the interpersonal and intrapersonal relationships, awareness of racial and cultural issues impacting mathematics teaching and learning as well as school policies and practices, play an important part in determining how PSMTs negotiate the various demands on their teaching professionalism with their professional and personal identities. Thereby showing that their journey to use culturally responsive mathematics pedagogical practices though challenging should be embraced, with fidelity, throughout teacher preparation programs to help better prepare teachers for diverse classrooms. Like other prospective mathematics teachers, the participants in this study have a tremendous desire to be successful teachers. They come into the teaching profession with a large repertoire of mathematics content knowledge. Nonetheless, this content knowledge, though necessary, needs to be coupled with intentional policies, practices, and expectations during their preparation to include and instill culturally responsive pedagogy.

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## APPENDICES

### Appendix A

#### Black Contributors to Mathematics and Mathematics Education

Mathematician(s) of African Descent	Date/Time Period	Origin of Birth	Contributions to Natural/Scientific Mathematics
Dogons	3200 B.C.	Africa	Architecture
Imhotep	2650 B.C.	Africa	Architecture
Muhammad ibn Muhammad al-Fullani al Kishnawi	16?? - 1741	Africa	Magic Squares
Benjamin Banneker	1700-1800s	The Americas	Self-Taught Astronomer, Mathematician, and Surveyor: Washington D.C.
James Ezeilo	1900s	The Americas	Ph.D. University of Cambridge Differential Equations
Ali Mostafa Mosharafa	1923	Africa	First African to Earn a Ph.D. in Mathematics
Elbert Cox	1925	The Americas	First African American to Earn a Ph.D. in Mathematics (1925)
David Blackwell	1941	The Americas	First African American to Obtain a Position at a Research University (University of California at Berkeley)
J. Ernest Wilkins	1942	The Americas	Ph.D. Mathematics
Euphemia Lofton Haynes	1943	The Americas	First African American Woman to Earn a Ph.D. in Mathematics
Evelyn Boyd Granville	1949	The Americas	Second African American Woman to Earn a Ph.D. in Mathematics Ph.D., Yale University
Majorie Lee Brown	1949	The Americas	Ph.D. Mathematics
Dorothy Vaughan	1949	The Americas	Mathematician NASA

Katherine Johnson	1953-	The Americas	Physicist, Mathematician, Computer Science NASA
Mary Jackson	1953	The Americas	Mathematician, and Engineer NASA
Grace Lele Williams	1963	The Americas	Ph. D. Mathematics
Ronald E. Mickens	1968	The Americas	Ph.D. Mathematics and Physics
Idris Assani	1981	Africa	Ph.D. Mathematics
William Massey	1981	The Americas	Ph.D. Mathematics
Nathaniel Dean	1987	The Americas	Ph.D. Mathematics
Oluwole D. Makinde	1987	Africa	Ph.D. Applied Mathematics
Katherine Okikiolu	1991	Africa	Ph.D. First Black to win Sloan Research Fellowship
Arlie Peters	1991	The Americas	Ph.D. Mathematics and Physics
Wilfrid Gangbo	1992	Africa	Ph.D. 1996 <i>The geometry of optimal transportation</i> remains the single publication by a Black person in the Mittag-Leffler Institute's Acta Mathematica
Jonathan Farley	1995	The Americas	Ph.D. Distinguished Fulbright Scholar
Serge Bernard	2000	The Americas	Ph.D. Applied Mathematics and Statistics
Naomi T. Cameron	2001	The Americas	Ph.D. Mathematics - Combinatorics
Nancy Glenn	2002	The Americas	Ph.D. Mathematics and Statistics
Monica Jackson	2003	The Americas	Ph.D. Applied Mathematics and Scientific Computations

## Appendix B

### Tenets of Culturally Responsive Pedagogy for Mathematics Classrooms (Specific to this Study).

CRP Mathematics Tenets	Description
Content Integration	The inclusion of mathematical content from students' cultures and many other cultures.
Facilitating Knowledge Construction	Teachers build on students' prior knowledge
Prejudice Reduction	Teachers use mathematics in context to build a positive, safe classroom for all students.
Social Justice	Teachers support the development of students' sociopolitical or critical consciousness.
Academic Development	Teachers support students in developing academic success in mathematics.

*Note:* [Adapted from](#) Hernandez, Morales, and Shroyer (2013).

## Appendix C

### Overview of Reviewed Literature

Title	Author	Purpose / Focus / Question / Topic	Finding(s)
<b>Affordances</b>			
Reinscribing urban: Teaching high school mathematics in low income, urban communities of color	Rubel, and Chu (2012)	To examine how teachers used a model of CRMP such as Centering the Teaching of Mathematics on Urban Youth (CTMUY) program to implement culturally relevant mathematics pedagogy (CureMap) in their mathematics classrooms.	When teachers are provided with a framework for teaching culturally relevant mathematics pedagogy (CureMap) students gained more opportunities to learn mathematics.
The development of a model of culturally responsive science and mathematics teaching	Hernandez, Morales, and Shroyer (2013)	To create a framework for specifically identifying culturally responsive strategies in science and mathematics teaching.	Found that schools need to have model representations of CRP for mathematics and science classes, and that schools need teachers who not only understand the importance of effective science and math instruction, but also who understand the increasingly diverse students in their classrooms.
Culturally responsive teaching in the context of mathematics: A grounded theory case study.	Bonner and Adams (2012)	To deconstruct the practices of a culturally responsive mathematics teacher in an effort to address the persistent gaps in mathematics achievement between students of color and White students at the classroom level.	Four cornerstones of culturally responsive mathematics teaching that were embedded in practice and foundational to pedagogy. These four cornerstones are knowledge, communication, relationships/trust, and constant reflection and revision.
Elementary mathematics teachers' knowledge of equity pedagogy	Jackson (2013)	Mathematics educators constantly discuss equity in the classroom, but do we know what knowledge teachers need to teach mathematics equitably to African American students? What specific knowledge related to equity in teaching African American students do eight successful elementary mathematics teachers have?	Teacher participants understood that relationships between teachers and Black children must precede instruction. Teachers who invested in African American students, and had high expectations of them both inside and outside of the classroom influenced their students' quality of life

“Good” mathematics teaching for students of color and those in poverty: the importance of relational interactions within instruction	Battey (2013)	This research documents the lack of access to what the field conceptualizes as quality mathematics instruction for underserved students.	The study found four dimensions in which relational interactions mediated access to mathematics: addressing behavior, framing mathematics ability, acknowledging student contributions, and attending to culture and language.
Using culturally ambitious teaching practices to support urban mathematics teaching and learning	Waddell (2014)	To advance a set of teaching practices in mathematics for urban teachers, called Culturally Ambitious Teaching Practices in mathematics (CATP) that considers the possibilities of developing academically challenging classrooms for all students.	The starting point for implementing CRP in mathematics classrooms began with the classroom environment. As fashioners of the classroom, teachers also need to think about how they situate themselves in the classroom community they are fashioning by thinking about their own personal beliefs, culture, and mathematical learning habits and how these beliefs and habits and its influence on their teaching practices and instruction.
Learners of mathematics: High school students’ perspectives of culturally relevant mathematics pedagogy	Hubert (2014)	To examine students’ perspectives of CRP and the effect that participating in culturally relevant mathematics instruction has on students’ attitude and interest toward mathematics.	Overall, the students had positive feelings toward culturally responsive mathematics instruction. Students preferred being taught mathematics using CRP versus the traditional method of instruction and that culturally responsive mathematics instruction helped to increase their interest in mathematics

## Constraints

Incorporating out-of-school mathematics: from cultural context to embedded practice	Wager (2012)	To identify how teachers, incorporate children’s cultural and out-of-school mathematics in instruction.	When teachers do not attend to how students use mathematics out-of-school students can develop narrow perspectives of school mathematics that is unrelated to how they think about real problems outside of school. when teachers drew on students’ community and cultural knowledge, students became more interested and successful in their mathematics content.
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Learning to enact social justice pedagogy in mathematics classrooms	Leonard and Moore (2014)	To examine Teacher Candidates' (TC's) assumptions and challenges as it related to enacting Social Justice Pedagogy (SJP) in the mathematics classroom.	Preservice teachers showed resistance to the use of culture in mathematics believing that "math is math", and did not understand "what culture had to do with mathematics".
Math anxiety and the "math gap": How attitudes toward mathematics Disadvantages students as early as preschool	Geist (2015)	To examine the attitudes of Head Start teachers toward mathematics and how it may influence how and what they teach in the classroom.	Teachers' negative attitudes toward mathematics have negative effects on the children they teach. Teacher feelings and attitude toward mathematics and their students influence mathematics anxiety in students, affect teacher curricular planning choices, as well as their own ability to teach mathematics as well. Although preservice teachers were open to the idea of teaching mathematics through real-world contexts, they were hesitant regarding the use of controversial issues, and often unable to provide concrete or non-trivial examples of what these different types of real-world contexts would look like in a mathematics classroom. The preservice teacher participants in the study also felt the need to avoid controversial topics based on the race and ethnicity of the students.
"I Just Wouldn't Want to Get as Deep Into It": Preservice Teachers' Beliefs about the Role of Controversial Topics in Mathematics Education	Simic-Muller, Fernandes, Felton-Koestler (2015)	To examine the beliefs that preservice teachers have about teaching real-world contexts, including those related to injustices, controversial issues, and children's home and cultural backgrounds.	Mathematics education as seen in the texts was decidedly not neutral, but was instead politically, socially and historically situated within a particular agenda.
Education for Whom? Word Problems as Carriers of Cultural Values	Bright (2016)	To examine mathematics curricular materials through the lens of two questions: "What is valued?" and "Knowledge for whom?"	Teachers were not engaged in culturally responsive mathematics teaching because they had the convenience and dominance of textbook based mathematics instruction
How do I teach mathematics in a culturally responsive way? Identifying empowering teaching	Ukpokodu (2011)	The purpose of this qualitative study was to explore teachers' inquiry regarding culturally responsive mathematics instructional practices and specifically to examine culturally responsive mathematics teaching practices.	Teachers were concerned about satisfying curriculum standardization and preparing students for high-stakes testing There was a lack of culturally responsive mathematics teaching models to emulate.

## Appendix D

### Informed Consent Form

Georgia State University  
Department of Middle-Secondary Education  
Preservice Secondary Mathematics Teachers Informed Consent

Title: Culture Matters: Preservice Secondary Mathematics Teachers Immersion and Use of Culturally Responsive Pedagogy to Teach Black Children Mathematics

Principal Investigator: **Dr. Pier A. Junor Clarke (PI)**; Natasha Ramsay-Jordan (Student PI)

#### I. Purpose:

You are invited to participate in a research study. The purpose of the study is to begin investigative and exploratory work that examines ways in which preservice secondary mathematics teachers (PSMTs) negotiate their experiences teaching Black children mathematics using culturally responsive pedagogy (CRP). We will document and reflect on how preservice mathematics teachers negotiate culturally responsive pedagogy in mathematics classrooms. Preservice mathematics teachers' experiences with CRP will be explored during their 100% online mathematics methods course and their face-to-face (f2f) mathematics methods course. We will analyze the connections among the use of CRP mathematics model, the tasks/activities and all course work during the courses and the PSMTs experiences in their clinical practices. Your participation will assist the current and future instructors and future preservice secondary mathematics teachers to gain insights as you implement instructional strategies to develop and enhance mathematical practices. A total of 4 participants will be recruited for this study. Participation will require a total of four hours for two different individual interviews. The first interview and its follow-up will last a total of 2 hours and will be conducted in the summer semester and the second interview and its follow-up will last a total of 2 hours and will be conducted toward the end of the fall semester of your current academic year.

#### II. Procedures:

If you decide to participate, Ms. Natasha Ramsay-Jordan will administer and collect consent forms. Ms. Natasha Ramsay-Jordan will also conduct both individual interviews. The first individual interview will take approximately one and a half hours, and will take place at a convenient time and place on campus to both researcher and PSMTs in the month of June 2016. The second individual interview will take approximately one and a half hours and will take place at a convenient time and place on campus to both researcher and PSMTs in the month of November 2016. Ms. Natasha Ramsay-Jordan will conduct all follow-up sessions and member checks. We will also ask your permission to use your course work, assignments, and reflections as a part of our data collection.



### III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

### IV. Benefits:

Participation in this study may not be of benefit to you and the program's current PSMTs but will likely benefit future PSMTs. Through your reflections on your experiences, learning, teaching and concerns about teaching mathematics using culturally responsive pedagogy (CRP), we will gain insights on implementing the CRP as a model for teaching mathematics more effectively, and to develop, and enhance the content standards and mathematical practices. Overall, our goal is for you to aid us in improving the teacher preparation programs to better prepare teachers for success in teaching diverse students in mathematics classrooms.

### V. Voluntary Participation and Withdrawal:

Participation in research is voluntary. You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled in the initial teacher preparation program. There will be no effects on your grades for the semester and/or program.

### VII. Confidentiality:

We will keep your records private to the extent allowed by law. Ms. Ramsay-Jordan will have access to the information you provide. Information may also be shared with those who make sure the study is done correctly (GSU Institutional Review Board, the Office for Human Research Protection (OHRP)). We will use pseudonyms that replaces your names on course and study documents. The information you provide stores electronically in password – and firewall-protected computers. Your name and other facts that might point to you will not appear when we present this study or publish its results. The findings will be summarized and reported in group form. You will not be identified personally.

### VIII. Contact Persons:

Contact Dr. Pier A Junor Clarke at 404-413-8411 or email at [pjunor@gsu.edu](mailto:pjunor@gsu.edu) or Ms. Natasha Ramsay-Jordan at 678-938-3604 or email at [nramsayjordan1@student.gsu.edu](mailto:nramsayjordan1@student.gsu.edu) if you have questions, concerns, or complaints about this study. You can also call if you think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or [svogtner1@gsu.edu](mailto:svogtner1@gsu.edu) if you want to talk to someone who is not part of the study team. You can talk about questions, concerns, offer input, obtain information, or suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

IX. Copy of Consent Form to Participant:

We will give you a copy of this consent form to keep. If you are willing to volunteer for this research and be audio recorded, please sign below.

_____	_____
Participant	Date
_____	_____
Principal Investigator or Researcher Obtaining Consent	Date

## Appendix E

### Demographic Questionnaire

Summer 2016	Questionnaire – 1 <sup>st</sup> Day of Class
Name: _____	
Do you have a degree in mathematics? _____	
What are some of your previous mathematics teaching experiences (e.g. tutoring etc?)	
What do you know about teaching in culturally diverse schools?	
What do you feel are some characteristics of an effective mathematics teacher?	
What do you think you need to learn about teaching mathematics to culturally diverse students?	
As a preservice teacher what are some ways you can learn from students with culturally diverse backgrounds?	
Describe what role you think teachers should play in encouraging pride in students' culture.	
Add 3 sentences to this statement: I believe that all children can learn regardless of cultural diversity.	
Add 3 sentences to this statement: Teaching students about cultural diversity will only create conflict in the classroom.	

## Appendix F

### Guide for Writing Personal Story of Experiences

Write a personal story about your immersion with culturally responsive pedagogy for the mathematics classroom and its impact on your teaching experiences. This personal story should detail your journey to become a mathematics teacher and include your experiences with culturally responsive learning activities both during the summer and fall, as well as your understanding and use of culturally responsive pedagogy for the mathematics classroom.

## Appendix G

### CRMP Readings and Guided Reading Reflection.

For each assigned readings, complete a reflection. Each reflection should be typed double spaced and include: (a) a summary of each reading (MINIMUM 6 sentences); (b) significant quotations from each reading (MINIMUM 6 quotations); and (c) comments regarding your struggles with the reading and/or how it will assist (or not) in your teaching of mathematics (MINIMUM 10 sentences).

Assigned Reading	Semester & Week
Ladson-Billings, G. (1995a). Toward a theory of culturally relevant pedagogy. <i>American Educational Research Journal</i> , 32(3), 465-491.	
Gay, G. (2002). Preparing for culturally responsive teaching. <i>Journal of Teacher Education</i> , 53(2), 106 - 116.	
Ladson-Billings, G. (1995b). But that's just good teaching: The case for culturally relevant pedagogy. <i>Theory into Practice</i> . 34(3), 159-165.	
Irvine, J. (1999). The education of children whose nightmares come both day and night. <i>Journal of Negro Education</i> , 68(3), 244-253.	
Ladson-Billings, G. (2009). The meaning of culture in mathematics education. University of Wisconsin Madison. Retrieved from: <a href="http://www.education.umd.edu/MIMAUE/institute/symposium/2009/Featured%20Speakers/The_Meaning_of_CULTURE_in_mathed.pdf">http://www.education.umd.edu/MIMAUE/institute/symposium/2009/Featured%20Speakers/The_Meaning_of_CULTURE_in_mathed.pdf</a> .	
Brandt, A., & Chernoff, E. (2015). The importance of Ethnomathematics in the math class. <i>Ohio Journal of School Mathematics</i> (71), 31-37.	
Bright, A. (2016). Education for whom? Taboo: <i>The Journal of Culture &amp; Education</i> , 15(1), 6-22. Review this as well: Chomsky, N. (2012). Education for Whom and for What? <a href="https://youtu.be/e_EgdShO1K8">https://youtu.be/e_EgdShO1K8</a> Retrieved from the internet on June 4th 2016.	

Kokka, K. (2015). Addressing dilemmas of social justice mathematics instruction through collaboration of students, educators, and researchers. *Educational Considerations*, 43(1), 13-21.

Bonner, E. P., & Adams, T. L. (2012). Culturally responsive teaching in the context of Mathematics: A grounded theory case-study. *Journal of Mathematics Teacher Education*, 15, 2538.

Stiller, S. (2011). Hooking students so they don't give up. In C. E. Sleeter & C. Cornbleth (Eds.), *Teaching with vision: Culturally responsive teaching in standards-based classrooms*. (pp. 82-99). New York: Teachers College Press.

Bush, W. S., & Greer, A. S. (1999). How do I find out what my students know and can do? In W. S. Bush & A. S. Greer (Eds.), *Mathematics assessment: A practical handbook for grades 9-12*. (pp. 10-35). Reston, VA: NCTM.

Johnson, S. M., Reinhorn, S. K., Charner-Laird, M., Kraft, M. A., Ng, M., & Papay, J. P. (2014). Ready to lead, but how? Teachers' experiences in high poverty urban schools. (pp. 1-25). *Teachers College Record*.

Hollins, E. R. (2012). Challenges, opportunities, and possibilities for learning to teach in urban schools. In E. R. Hollins (Ed.), *Learning to teach in urban schools: The transition from preparation to practice*. (pp. 1-20). New York: Routledge, 2012.

Matthews, L. E., Jones, S. M., & Parker, Y. A. (2013). Advancing a framework for culturally relevant, cognitively demanding mathematics tasks. In D. Martin & J. Leonard (2013). *The brilliance of Black children in mathematics: Beyond the numbers and toward new discourse*, Ch. 6, 123-150, Information Age Publishing.

Teel, K.M. (2008). A White educator's ongoing journey: Toward racial and cultural competence. In K.M. Teel & J.E. Obidah, eds. *Building racial and cultural competence in the classroom: Strategies from urban educators*, Ch. 11, 136-151. NY: Teachers College Press.

## Appendix H

### Lesson Plan Template

Lesson Title:

Grade and Subject:

Date:

LESSON PLAN LEARNING OUTCOMES AND PROCEDURE	
<b>Essential Question(s) / Central Focus</b>	Name 1-3 essential questions for the lesson. Essential questions relate to the most important intellectual and conceptual knowledge you intend students to learn from this lesson. These questions should guide your instruction and reflect your learning objectives.
<b>Learning Objective(s)</b>	Include (in a bulleted format) all of the learning objectives of the lesson. Learning objectives must be clear. They are also measureable and should be linked to students' cultures/identities, personal and academic needs, learning standards, and assessments. Objectives for excellent lesson plans should also be linked toward advancing students' skills/proficiencies, intellectual development, identity development, and agency.
<b>CCGPS or GPS Standard(s)</b>	Include the number and texts all of the aligned state adopted learning standards and/or Common Core State Standards for your specific discipline.
<b>Cultural Context</b>	<p>Identify, Discuss, Justify, and Describe, Cultural Connections</p> <p>It is important to keep backwards design (beginning with assessments and standards) and essential, enduring questions in mind while planning (Wiggins &amp; McTighe, 1998). Enduring questions are bigger questions. They are the relevant, broader questions guiding our teaching and learning and are intended to help students make connections to and meaning from learning. These questions should relate to students' lives outside of and beyond the lesson and the classroom doors.</p> <p>Think about you class/population and explain why this lesson was developed for those particular students. <i>Justify</i> the content, the approaches, the assessments, and the strategies chosen. <i>Think critically</i> about how the lesson or lessons fit into the larger, overall objectives for the class and how they relate to the students' broader lives and lived experiences. <i>Defend</i> your pedagogy and pull from your readings to justify the lesson's pedagogical soundness. <i>Cite</i> any sources you use.</p>

<b>Instructional Strategies &amp; Learning Tasks that Support Diverse Student Needs</b>	Introduction to Lesson	<p>In a narrative format describe how you plan to capture the interest and excitement of the learning. In other words, what is the “hook”/engaging activity for the lesson to activate thinking?</p> <p>The introduction should tie directly into the lesson’s objectives and standards and should promote intellectual advancement. This is a good opportunity to layer multimodal forms of texts (short and powerful excerpts of print, image, video, and sound). Include the length of time intended for the introduction.</p>
	Body of Lesson	<p>Using a chronological structure, write out each detailed step of the lesson. Walk the reader through your instructional plan. You should include what you will model, explain, or demonstrate and your varied/differentiated instructional approaches toward these ends. Include notes on how you will transition between activities and manage the class. Be as detailed as possible and include a clear view of the students’ and teacher’s roles in the process. Pay special attention to the variation of interaction patterns in the classroom (teacher-student, student-student, etc.) and how often whole class/individual instruction/cooperative learning takes place. Include the length of time intended for this part of the lesson. Include language supports for academic language embedded in the learning task.</p>
	Closure	<p>In a narrative format, explain how students will summarize and/or share what they have learned to prove they know and understand the learning standards, objectives, and vocabulary. Include any “next steps” for future lessons that you foresee. Include the length of time intended for this part of the lesson.</p>
<b>Learning Supports: Differentiation, Modification(s) and Accommodation(s)</b>		<p>In a narrative or bulleted format, describe how you give instructional support for your students with special needs (<b>IEP, special education, ESOL, struggling readers/writers, students with exceptionalities</b>). In all lessons, you want to make it impossible for students to fail. Describe the modifications and accommodations toward this goal.</p>
<b>Formal and Informal Assessment</b>		<p>In a narrative format, describe how you plan to assess students’ learning formally AND informally. As you are doing this, state any formative and/or summative assessments. The assessment should be tied to all other parts of the lesson plan.</p>



		<p>The assessment should provide evidence of student achievement on each learning objective.</p> <p>Formal Assessment:</p> <p>Informal Assessment:</p>
<b>2. RESOURCES</b>		
<b>Academic Language</b>	<b>Language Functions</b>	<p>Identify a key learning task for practicing this function.</p> <p>Identify the purpose for which the language is being used, with attention to goal and audience—the <u>one verb</u> from the learning standards (ex. demonstrate, argue, explain, justify, define etc...). This section should briefly explain what tasks students are expected to perform and what they are expected to do with language.</p>
	<b>Vocabulary</b>	How will students demonstrate (reading, writing, listening, and/or speaking) their understanding of vocabulary in relation to the language function listed above?
	<b>Syntax or Discourse</b>	How will students demonstrate (reading, writing, listening, and/or speaking) their understanding of the syntax/discourse?
<b>Materials</b>		In a bulleted but detailed list, name all of the materials that will be used in this lesson. Attach all handouts (used to support your instruction), presentations, copies of text used and assessment materials.
<b>Technology</b>		Briefly describe the technological resources (including the use of multimodality) that will be integrated into this lesson. Justify the choice of technology.

Source: Adapted from - Irvine, J. J., & Armento, B. (Eds.) (2001). Culturally responsive teaching: Lesson planning for elementary and middle grades. Boston, MA: McGraw-Hill.

## Appendix I

### Interview Protocol

Fall 2016	Interview Questions (Clarifications)
	<ul style="list-style-type: none"><li>• Describe in your own words your feelings about the importance of mathematics.</li><li>• How has the use of culturally responsive pedagogy for mathematics classrooms influence your own teaching of mathematics to Black children?</li><li>• Explain what you have done or might do to support Black children struggling in mathematics.</li><li>• Explain what you have done or might do to connect your students' cultures to mathematics.</li><li>• What has been your most enjoyable experience while teaching mathematics using culturally responsive pedagogy?</li><li>• Do you feel you possess the character traits needed to be a successful mathematics instructor of Black students?</li><li>• What has been your worst experience while teaching mathematics using culturally responsive pedagogy?</li><li>• What are the characteristics of a successful mathematics student?</li><li>• What do you think you need to know about teaching in urban schools?</li><li>• By the time your students leave your mathematics classroom what should they know?</li><li>• In your opinion why do you think mathematics is important?</li><li>• What are some of the ways you communicate mathematics?</li><li>• Do you believe that teaching mathematics is cultural?</li></ul>

Note: Adapted from

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Walshaw, Unpacking pedagogy: New perspectives for mathematics classrooms. (pp. 43 – 63). Greenwich, CT: Information Age Publishing.

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## Appendix J

### MEMORANDUM TO PARTICIPANTS CONCERNING MEMBER CHECKING

To: Study Participant  
From: Natasha N. Ramsay-Jordan  
Date: November 21, 2016  
Subject: Member Checking

Dear Participant:

First, thank you for participating in my dissertation research study. The purpose of this letter is to member check my case study. Member checking is a process in which the researcher (me) share information with research members (you) to produce valid, credible, and accurate research findings.

I have written a distinct case for you as a participant. I have changed your name, the names of institutions mentioned, and companies you worked for to ensure anonymity and confidentiality. The goal of the use of pseudonyms is so that readers will not be able to pinpoint who you are.

Please read your case study and correct any errors that I have made. Also if my interpretations of a given situation are incorrect, please correct me. I have provided you with a member check comment sheet to make comments about your case. Please write about and/or highlight changes you feel are necessary to your case. If you find errors too numerous and need further clarification, please let me know.

I sincerely thank you for your time and participation in this study.

Natasha Ramsay-Jordan  
Doctoral Candidate-Mathematics Education  
Georgia State University  
Cell: (678) 938-3604  
Email: [nramsayjordan1@student.gsu.edu](mailto:nramsayjordan1@student.gsu.edu)    [asrurati\\_99@yahoo.com](mailto:asrurati_99@yahoo.com)

## Appendix K

### Member Check Comment Sheet

Page Number(s)	Write Name Here	Comment

## Appendix L

### Interactions with Participants

Date	Event	Participant	Length of Time
June 6 <sup>th</sup> , 2016	1 <sup>st</sup> Day of Summer Semester I Administered Questionnaire and Informed Consent Forms to all students enrolled in mathematics methods course including those that would eventually be chosen for the study.	All Participants	.5 hours
June 12 <sup>th</sup> , 2016 - July 31 <sup>st</sup> , 2016	Engaged in online discussions about CRMP readings assigned for Summer Semester.	All Participants	On-line
June 21 <sup>st</sup> , 2016	Mirror and Window Activity	All Participants	1.0 hour
July 5 <sup>th</sup> , 2016	Summer Teaching Exhibit. Participants showcased their use of CRMP practices in summer class activities.	All Participants	3.0 hours
August 22, 2016 - December 31, 2016	Engaged in online discussions about CRMP readings assigned for Fall Semester.	All Participants	On-line
August 22, 2016	1 <sup>st</sup> Day of Fall Semester Discussed course objectives as it pertained to CRMP. Discussed CRMP reading reflection expectations, and CRMP assignment.	All Participants	
September 29, 2016	Discussed CRMP Writing Assignment. Answered questions and concerns Engaged in Discussions about CRMP.	All Participants	2.5 hours

November 12, 2016	Individual Interviews: Clarification	Susan (2:00 p.m. -2:30 p.m.)	.5 hours
		Rose (4:00 p.m. – 4:30 p.m.)	.5 hours
December 12, 2016	Individual Interviews: Clarification	Amanda (2:00 p.m. -2:30 p.m.)	.5 hours
		Marlene (4:00 p.m. -4:30 p.m.)	.5 hours
December 28, 2016	Member Checks	Susan (1:00 p.m. -1:30 p.m.)	.5 hours
January 2 <sup>nd</sup> , 2017	Member Checks	Rose (2:00 p.m. -2:30 p.m.)	.5 hours
January 3 <sup>rd</sup> , 2017		Marlene (5:00 p.m. -5:30 p.m.)	.5 hours
January 5 <sup>th</sup> , 2017		Amanda (4:45 p.m. -5:15 p.m.)	.5 hours

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## Appendix M

### Mirror and Window Activity

